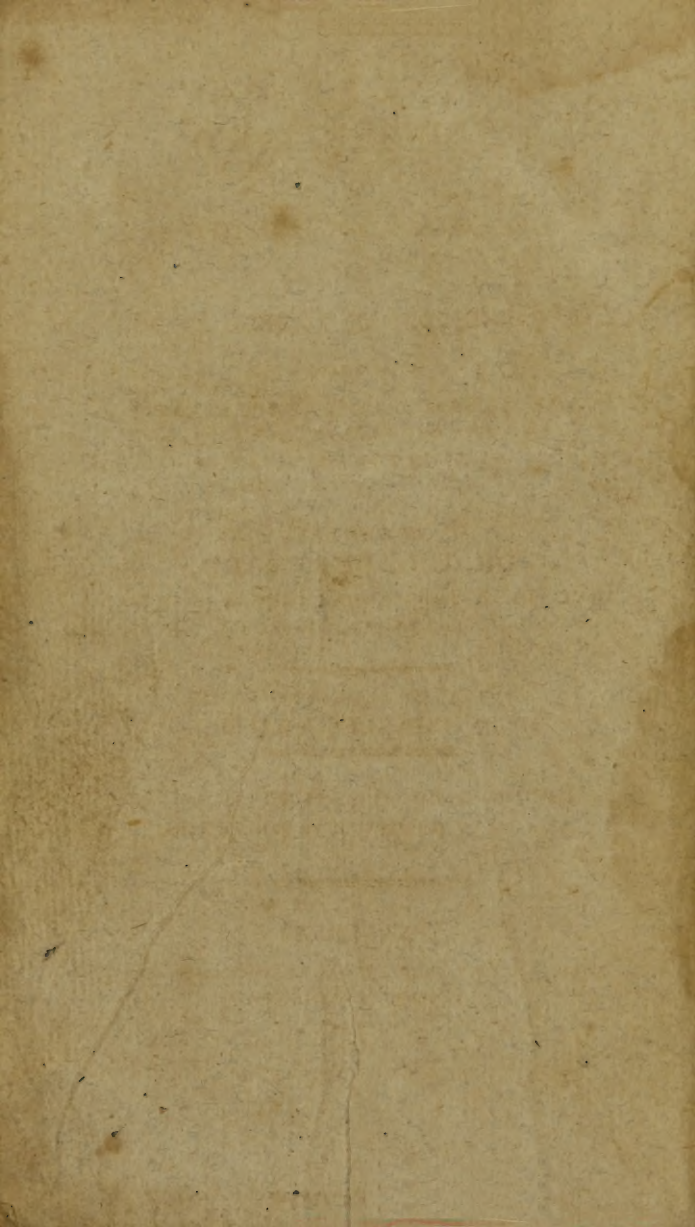


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ELEMENTARY
OR
FUNDAMENTAL PRINCIPLES
OF
The Philosophy of Natural History:

LEADING TO
A BETTER KNOWLEDGE OF THE CREATOR
AND THE CREATURES, AND ESPECI-
ALLY OF THE DESTINATION
AND DIGNITY OF MAN.

BY THE REV.
DR. I. G. BURKHARD,
MINISTER OF THE GERMAN LUTHERAN CHURCH
IN LONDON.

TRANSLATED FROM THE GERMAN
BY CHARLES SMITH.

"Remember, man, the UNIVERSAL CAUSE,
"Acts not by partial, but by general laws."

POPE.

NEW-YORK:
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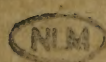
1804.

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THE
JOURNAL OF THE
ROYAL ANTHROPOLOGICAL INSTITUTE
OF GREAT BRITAIN AND IRELAND
VOLUME 11 PART 1 1881

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ALFRED C. HENRIKSEN
AND
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MR. CHARLES SMITH,

SIR,

THE SOCIETY OF ASSOCIATED TEACHERS, of the city of New-York, having perused your translation of a work, entitled, ELEMENTARY OR FUNDAMENTAL PRINCIPLES OF THE PHILOSOPHY OF NATURAL HISTORY, &c. by the Rev. Dr. I. G. Burkhard, consider it as a work which, within the bounds of a small volume, contains the essence of those discoveries which have resulted from the researches of the most eminent philosophers of natural history; and as well calculated to inspire a grateful admiration of the power, wisdom, and goodness, of the Supreme Being, which are displayed in the vegetable and animal creation. We therefore recommend it to the perusal of all those who are desirous of acquiring a knowledge of natural history; and particularly to the attention of those who are concerned in the instruction of Youth.

ANDREW SMITH, PRESIDENT.

New-York, June 20, 1804.

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The high reputation which the ELEMENTARY PRINCIPLES OF THE PHILOSOPHY OF NATURAL HISTORY, by Dr. Burkhard, have gained on the continent of Europe, by all thinking men, and especially by those who are engaged in the arduous pursuits of education and instruction, has induced me to introduce this work to the American public. The author's preface fully explains his views, and if the work should in some degree become conducive to the improvement of youth, and encrease our knowledge of our Creator and his creatures, I shall consider myself highly rewarded for my labour.

TRANSLATOR.

New-York, June 20.

PREFACE.

THE PHILOSOPHY OF NATURAL HISTORY is an investigation into the causes, designs, and effects of natural appearances, and especially of the animal kingdom...into the objects of the creation, and the means which were used to attain those objects.... into the connection of the whole, wherein all, from the greatest to the smallest, like the links in a chain, like wheel to wheel in a clock work, are fitted together with apparent wisdom....into the simplicity of the plan which operates so many thousand various ways...and into the utility and influence which such a knowledge of the creatures has and may have on other knowledge highly important to man, and on the elucidation of all other sciences.

Without such an application of natural history, it becomes useless, and loses much of its charms. Natural philosophers, with the most laudable zeal, therefore, have not only like Linnæus and Buffon, taken pains to arrange the innumerable creatures of every kind in the creation, into systems and classes, but also like Derham, Ray, Lesser, Fabricius, Swammerdam, Haller, Nieuwetyt, Reimarus, Sander, Sturm, &c. to connect those prin-

ciples, and the knowledge drawn from experience and experiments, with other sciences of theology, physic, and economy, and thus to make nature the great teacher in every branch. Such searches into natural history, what detriment have they not been to superstition! What light has not thereby been thrown upon religion! With what happy success has not the similitude between the cause of nature and the higher revelation, been discovered, and the secrets of the Holy Scriptures with the secrets of nature, equally inexplicable, been justified and confirmed! Many discoveries are yet to be expected; and religion and morality, politics and legislation, commerce and the arts, will gain in proportion as these objects are brought nearer to the original arrangement of nature. It is from experience only that we can draw sure and general conclusions, where the doctrine is formed by examples, and the evidences by facts. There is nothing more desirable than to lead youth, besides the languages, to such knowledge. Lord Bacon long ago has been wishing that the usual mode of studying should be reversed, and that young people should not begin with speculative systems, but with facts drawn from natural history. According to his opinion, the encyclopædia of all sciences, and the philosophical transactions of learned societies, would be the most useful school-books. Many a one has repented it, when too late, that he had neglected the first and most important of all sciences, viz. the mathemat-

ics, pharmacy, chymistry, geography, and natural history.

The following fundamental principles of a philosophy of natural history, leading to a better knowledge of the Creator and the creatures, and especially of the destination and dignity of man, are chiefly taken from Smellie's Philosophy of Natural History. I have endeavoured to make this extensive and expensive work, by extracts and additions, generally useful. They are but outlines....hints....which may excite farther study and attention to the most remarkable animals.

The object is to lead to a better knowledge of the Creator and the creatures, but especially of the destination and dignity of man :

TO A BETTER KNOWLEDGE OF THE CREATOR.

All men of sound sense agree, that there is a first cause of all things. Every where we perceive in the works of the creation, design and developement, object and end, means and order, art, harmony, measure; every where the effects of a higher power, wisdom, and goodness....in short, God; the master-builder and creator. But some philosophers seem to consider that first cause as something else, I do not know what; and lose themselves so far as to mistake the effect for the cause, and to call Creator what really is creature. To which belongs the im-

prudent use of the word nature. What is nature? Is it a certain property and regulation of the creatures, a certain inherent power? then it certainly is effect, and we may use the word without expressing ourselves unphilosophical or incorrect. But if we mean thereby the first operating cause which gives to the creatures those properties, motion, power, activity....then we ought to give it the name of Creator: then we would know what idea we have to combine with the word. Every one that regulates his thoughts by the rules of common sense, will immediately have a conception of the Being of all beings, as far as we at present are capable of forming such conception. But, if we say, Nature forms its works with great wisdom....nature does nothing in vain....nature provides for the necessities of all its children, &c. then we can excuse the expression in no other way than by calling it a poetical, figurative expression, and we cannot refrain from calling nature a good-hearted mother, a prudent lady. But it is philosophically incorrect. They mistake cause for effect, Creator for creature. But it is the province of the philosophy of natural history to lead us to clear conceptions of cause and effect, and to the knowledge of the great wisdom and goodness of the Creator, which shines forth from all, and even from the smallest works of nature. It is in the smallest and most insignificant creatures wherefrom we can draw the most exalted ideas of his greatness; for they are the links in a chain, parts

of a whole, which the clearest understanding, in balancing all powers and the original regulation of all things, must think as necessary as the greatest work. Those sages, who ascribe every thing to the connection of the whole, and to mechanism, and deny the providence of the Creator, we cannot coincide with, till they prove, that a concerto can be composed without notes, or a book be read without letters.

TO A BETTER KNOWLEDGE OF THE CREATURES.

The thought, that not one individual creature is produced without design, and that even the most insignificant reptile is a necessary link in the chain of living beings, ought to be familiar to us. It would lessen the disgust we feel against many creatures, especially against reptiles and insects. Every creature has the feeling of life, and each is in its nature happy during its short or long existence. But it is evident that the animals are in existence for the economy of the whole, and this whole for man. Man, therefore, may kill animals and use or convert them to his use, but he must not torment them. They have feeling ; they plainly express their pain by their cries and agonies ; and if their instincts do not justify us to attribute to them reason, they plainly show that they are capable of feeling pleasure and pain, and that it is our duty to shew to them some kind of esteem and humanity. This would be acting according to the situation of things. But at last,

TO A BETTER KNOWLEDGE OF THE DESTINATION
AND DIGNITY OF MAN.

Some philosophers have endeavoured to degrade man. It seems, that they not only wish to exile us into the wilderness, and to live upon a level with other animals, in order to live according to our destination, but, by their mode of philosophizing, we are below the brute creation. Such a son of nature, or many of them, as they have described, are far more contracted and miserable than a herd of quadrupeds. But natural history every where shows us the advantages and preference of man in the external form as well as in the mental powers; and to think and act according to the situation resulting from it, is the first duty of man.

These are the objects of this publication. It does not contain any new discoveries; its object is to bring the already well known and useful truths more into circulation. Natural history conveys both knowledge and pleasure; it therefore is not difficult to unite utility with amusement. It is our ardent wish, that the youth, or other readers in whose hand this work may fall, might indeed find in it that agreeable combination of instruction and amusement.

LONDON, &c.



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ELEMENTARY
OR
FUNDAMENTAL PRINCIPLES
OF
The Philosophy of Natural History :

GENERAL OBSERVATIONS ON THE CONNECTION
OF THINGS.

SECTION I.

GRADATION AND CHAIN OF THE ANIMALS.

NATURAL philosophers have long since observed, that all the creatures on this globe are in a relative connection, dependance, and form as it were a chain, from which no link, however insignificant, can be taken, without injuring the whole. Men, who are not given to reflection, are surprised why the Creator has produced certain insects and reptiles. But

they do not consider that if one single species were wanting, there would be a *vacuum* in nature. Pernicious and disagreeable as many are to man, they are necessary in the chain of things to afford food to others. Were they wanting, other agreeable and useful animals would become exterminated, or they would prey upon other animals, and thus a general devastation would take place, till at last man himself would become extinct, and all nature be without life. This is a sure means to lessen the disgust which many men have to certain animals.

Man, without doubt, takes the highest grade among the animals ; he is the most important link in the chain of living and visible beings upon earth, and from him descend all the other members of the animal kingdom, in an almost imperceptible gradation. As a rational creature, cultivated by the arts and sciences, he is, as it were, connected with higher beings wherever they may exist ; he is the sovereign of nature. By considering the works of the creation, he forms some feeble knowledge of the first cause that produced them, and he ascends upon the ladder of the creatures to the exalted idea of the Creator himself.

Were we to ask why men are not endowed with the knowledge and powers of angels? then we ought also to ask why animals do not possess the faculties of men?...such questions are useless and over wise. Suffice it, that each animal is in its nature good, and in its destination perfect....Should we exalt or debase certain beings, the whole system of things would be altered, and a world different from this be produced; hence we are to consider every creature in its relation with the whole, and in what situation it is with respect to others. From man down to the mawd, there is a great distance indeed; but this distance is filled up with sensitive beings, who follow each other in so imperceptible a gradation, as the mixture of colours in the rainbow. They all are as perfect as their relative situation with the whole requires. Even among men, who form a gradation of their own, the difference of faculties is evident. What a difference between the soul of a Leibnitz, a Newton, and that of a Hottentot! But it is ordered so by infinite wisdom. Should men all be endowed with equal wisdom and knowledge, the occupations of life would be neglected, an society could not subsist. It is industry, difference of capacity, and natural disposition,

whereby men are kept together. The Gentoos in Hindostan are divided, according to certain religious and political principles, into different races : but it seems that this arrangement proceeded originally from a consideration on the difference in the human faculties ; for the Creator himself has, in that respect, not made men alike. Some evidently possess greater capacities, but even those differ in their views, inclinations, and taste. Could we follow up the examination of this diversity throughout all nations, provinces, cities, and even families ; could we have a view of the whole, we should be surprised at the difference that reigns even among one and the same species.

Distinguished and exalted as man is, in comparison with other animals, it is a humiliating observation, that there are men who seem to be almost brutes. The larger and smaller Ourang-Outangs are again linked, by an imperceptible gradation, to other apes, that also have no tails ; those again with such as have short or long tails, and who fill up the chain of imitating animals, which have so disagreeable a resemblance with the structure and morals of human nature. Yet in other respects care seems to be taken that man can never be con-

founded with the brute. Such animals as resemble men the most by their faculties, viz. the elephant, the horse, the dog, are in their bodily structure entirely different.

Such animals who in their structure resemble men the most, as some of the monkey kind, differ very much in the operation of their faculties. A monkey may be taught to imitate every thing, and wait at table ; but let fruit be placed upon the table, and he never will forget his natural propensity. The Ourang-Outang snores like a swine.

Considering the characteristics of the animals, we observe, that some particularities wherein they differ are more general and admit of more diversities than others. Hence it is that we divide them into classes, kinds, and orders. But between two kinds there are creatures that bare so much analogy to both, that we are at a loss which to place them to : they therefore form as it were the link whereby both are united. The polypus, which grows and propagates whilst shooting twigs, or is cut off, links the animal kingdom to the plants. The worms that live in sandy reeds, seem to unite the insects with the shell animals, whose

muscles and organs of motion are thus placed on their external instead of their internal parts. From the reptiles the gradation rises more perceptible in the perfection and motion of their organs: the number of their organs and the structure of their bodies have more analogy with the animals which we place among the perfect ones. The snake, on account of its form, motion, and manner of living, is united with the eel and the water-snake. Most fish are, like the reptiles, covered with scales, whose colour and diversity teaches us to distinguish one kind from the other. The form of fishes is in some long, in some broad and short, in some cylindrical, in some flat and broad, in some square or like a circle: their fins, in the element they inhabit, are to them the same that wings are to the birds in the air: their heads, like those of the reptiles, are, without a neck, connected with their bodies. The flying-fish, whose wings resemble those of the bat, forms the communication between the fishes and the birds; among which the water-birds follow the flying-fish.

The difference between the fish and amphibious animals, and the land animals, is as imperceptible: the sea-lion, the crocodile,

the turtle, the sea-dog, have in their internal and external structure so much analogy with the land quadrupeds, that some natural philosophers have placed them in the same class. The bats and the flying-squirrels, who cross the air with wings of skin instead of feathers, evidently link the quadrupeds with the bird creation. The ostrich, with several others, who rather run than fly, form another link between those different kinds.

Thus every thing is linked together by a great chain in inanimate and animate nature. What gradation and difference is not there from the diamond down to the dust! among the plants, from the oak to the moss! among the animals, from the elephant to the mawd, from the eagle to the fly!....and each creature, in their intermediate spaces, is in the same place and of the same use which it must have in the formation of the whole : alter its place, and another world is requisite to hold such a creature in it. Therefore we must consider every creature but in the relative situation it is placed with others ; as a part of the whole, as a link of the chain. We indeed consider certain things and creatures as evils, but remove those evils and you will annihilate even those who complain of them. The opposite ope-

ration of the solid and fluid parts upon each other, produces natural life ; the continuation of this operation is the natural cause of death. Immortality of the body, therefore, presupposes a system of things quite different from the present. Each animal and each plant ascends by degrees from an embryo to that perfection peculiar to their different gradations. The union of all those relative perfections forms the perfection of the whole. All the planets are with the sun and with themselves in an equilibrium. Our globe presses with its weight upon other bodies, and those upon our globe. The whole creation, therefore, is linked together by an imperceptible connection of all the animate and inanimate beings ; and had we no other evidence of the *unity* of God, we should be convinced of it by the connection that is formed of all things to one *great purpose*.

And so does man in this gradation of nature occupy the place allotted to him by infinite wisdom ; and this must afford him consolation in his situation. Had he higher powers, and should he be free of those weaknesses and evils that now befall him, he undoubtedly would be less happy than he does imagine. Should his senses be finer and more acute, his know-

ledge more penetrating, his taste so refined that no object around him could satisfy him, and every means of nourishment too rough, his life would be to him a burden. The more enlightened and refined, therefore, the human mind grows, the more insupportable becomes to it the sameness in the objects and occupations, the tasteliness and vacuity in earthly enjoyments and pleasures. Should the same sensibility, the same situation and occupation, the same contractedness continue forever ; should the source of so many sufferings, whereby the enjoyment of life is heightened as light is by the shadow, life also would to him become a burden, which he at last would wish to exchange for death. Even death, therefore, becomes to us a benefice, if we expect it without tremor and anxiety, as soon as it calls us off according to the course and order of nature.... Enjoy, therefore, O man, your existence as long as it lasts ; behold and admire the great works of the Creator, among which you occupy so important a station ; consider every evil as the cause or effect of a greater and of the general good ; support the place allotted to you with principles and actions becoming your destination and dignity ; live and die as it pleases God : in this consists your whole duty.

DIFFERENCE BETWEEN ANIMALS, PLANTS, AND
STONES....ANALOGY BETWEEN ANIMALS AND
PLANTS.

THE works of nature, which are so closely connected, bear certain external marks and signs, whereby they are distinguished, and which are conspicuous even in the animal and the most common of men. This was necessary in order to promote the occupations of the animal world, and to keep them in their proper train. But the eye of the philosopher discovers other and almost infinite smaller differences and proportions. Nothing is easier than to distinguish at first sight an animal from a plant, and yet natural philosophers have not yet agreed in their descriptions. Baron Charles Linneas, who has immortalized himself in his researches of natural history, describes the limits of the three kingdoms of nature in these few words ; stones *grow*; plants *grow and live*; animals *grow, live, and feel*. With this description we must be contented, imperfect as it is : growth, life, and sensation, are conceptions which we never shall be able to investigate to their foundation. But by observing nature, we find that there is a great difference between stones, plants, and animals,

though animals and plants bear greater analogy to each other than stones to plants and animals.

Sensation, motion, and mental power, united with faculties by means of the organs, form the being of the animals. It is by their senses that they are united with distant objects. They protect themselves by resistance, swiftness, and art. But plants remain constantly on the same spot, and are subject to every thing that moves. Animals do not eat constantly; they want time for digestion, and the secretion of nurture. But the structure of plants is more simple; they inhale their nurture constantly without being hurt. Animals chuse certain victuals; but plants must receive what the elements convey to them. Animals can live upon the surface, in the bowels of the earth, in the air, in water, in the bodies of men and other animals, in the internal parts of plants, even in stones: but, with the exception of some aquatics, the plants are riveted by their roots to the earth. Most of the animals have a heart, or a power to distribute their juices to the different parts of the body: but caterpillars, and many other insects, have no such general receptacle.

The power of motion has been considered as an essential property of the animals ; but this criterion is uncertain. The oyster and several other animals do not seem to have it. Many kinds remain on the rocks where they received their existence, and have no other power than to expand and contract their bodies. Besides, we can observe a certain motion also in plants. If the roots of a tree meet with a stone or any other impediment, they change their direction, and shift it even from a dry to a fertile soil ; which certainly is a species of choice of the means of nourishment. Plants, confined in a house turn uniformly, like the polypus, to the window or the aperture through which the light enters. The sensitive plant, at the least touch of its leaves, shrinks up and bends with them to the ground. But the moving plant, that grows in the East-Indies, is irritated to certain motions by the sun-beams only. Whilst the sun shines, the leaves move in every direction, but particularly up and down ; sometimes they become entirely inverted : this lasts during the heat of the sun ; but at night and in cold foggy weather the motions cease. We observe in this plant quick and uniform motions, and infer therefrom, that the leaves of all plants move under the in-

fluence of the sun's rays, though too slow for our observation. A certain American plant is, as it were, a trap for flies, and affords another proof of vegetable motion: its leaves are provided with two rows of prickles, which yield a sweet juice that attracts the flies: if a fly touches those parts, the lobes suddenly close and squeeze it to death. It produces the same motion if it is touched with a pin or a bit of straw. If one of its seeds is put into the ground reversed, the young root will turn into the ground, but the germ will turn upwards towards the air. If we bend the young germ downwards, its point will always resume its former perpendicular situation. If the branch of a tree is bent so that the lower surface of the leaves is turned upwards, they will in a short time turn to their original position. Many leaves, such as poplar, follow the course of the sun: In the morning their upper surface turns towards the east, at noon towards the south, and at sunset towards the west. During night or in rainy weather they are horizontal, and their lower surface turned towards the ground: the leaves are constantly in motion, even in calm weather.

The sleep of the plants is another species of vegetable motion or irritability. The leaves of many flowers and plants close at night, and at sunrise open again with renewed vigor; and indeed the appearance of many is so different at night, that at day light we should scarcely consider them as the same plants. It is remarkable, indeed, that all prepare for their sleep in such a manner as to afford their germs, flowers, buds, or fruits, the best protection. The leaves of the tamarind tree enclose the tender fruit so firmly as to protect it against cold. And in this manner many other plants draw their leaves together.

The cause of this motion of the plants has been attributed to the presence or absence of the sun, and evidently heat or cold contributes to it. But it has frequently been observed that in hot houses, where day and night an equal temperature is retained, the plants sleep in the same manner and close their leaves in the same manner as if they were in the open air. Their sleep, therefore, must be more the effect of certain laws of motion than the quicker or slower fluidity of their juices.

The stomach and brains are as uncertain proofs of the difference between animals and plants. The polypus has no stomach, or is rather like plants, all stomach. Its interior contains no intestines, and if the inside is turned outside, it continues to live, and digests victuals as if nothing had happened to it. The manner in which plants are nourished, has a great similitude with that of the animals. They receive their nurture by means of the roots, the stem, twigs, leaves, and flowers. Instead of being provided with a stomach, their whole structure is stomach. What the stomach is to animals, the roots are to plants. The polypus and many other insects indeed have no brains; but we must consider, that they are the intermediate creatures which link the animal kingdom with that of the plants, and must therefore have something of each.

But all animals possess sensation, which is considered as a mark of extinction of the animal life. But sensation certainly encompasses the idea of pleasure or pain. We presuppose the existence of sensation in organized bodies, if they have organs similar to ours, or if we, under certain circumstances, see them act as we do. If the creature has eyes, ears, or a

nose, we conclude that those organs convey to them similar sensations. If we see a creature without those organs, which nevertheless when touched shrinks up, one that turns its head uniformly towards the light, or one that encloses insects with a kind of arms, then we believe it to possess life. If we cut off its arms, or deprive it of the power of expanding or contracting its body, it will still remain the same creature, but we are no more able to determine whether it possess life. This is the case with the pieces cut off of a polypus, before heads are grown out. The circular animals, the small eels in the wheat fields, prove that every sign of life or of irritability can be suspended not only for months but for whole years, without the life itself in those creatures being extinguished ; for in humidity they come to life again. Those and similar circumstances instruct us, that we are yet but little acquainted with the nature and properties of life. It is something spiritual and mysterious, that our understanding cannot conceive or our senses reach or distinguish. It is possible that there can be life in dead bodies who seem to be as inanimate and dead as stones ; and had we no other criterions of life, than motion, sensation, and irritability, the abovementioned little animals

would be dead many years since. It would therefore, be a precipitate judgment that would exclude the plants from every species of sensation. For the gradation of sensation, from man to the most imperfect animal, is as imperceptible and as different as the relative station which each takes in the chain of beings. Not only the sensitive, but every plant, shrinks up if wounded. In most of them the motion is too slow for us to perceive. Trees that grow near a rivulet whose roots take a direction that would bring them to the open air, will find their way below the rivulet, traverse it, and take root on the opposite shore. If we remove the earth from a root, without exposing it too much to the sun-beams, and place a wet sponge in a different direction, but near the root, it will in a short time turn towards the sponge. The direction may be altered in different ways. All plants endeavour, by various windings, to avoid darkness and shades, and to retain the influence of the sun. Put a wet sponge underneath the leaves of a tree, they soon will bend down and endeavour to touch it. Put a vase full of water six inches from a growing cucumber, within twenty-four hours its twigs will turn to the right and left, and will not rest till they have reached the water. Put

a pole into the ground at some distance from a stem of vine, that is not already supported by a pole, and whose branches have taken an opposite direction, and in a short time they will turn towards the pole till they encircle it. This excites our surprise; there seems to be life, sensation, but not that kind which in animals is connected with pain or pleasure.

There is still a lower kind of sensation, which is called *irritability*. This expression denotes the power whereby muscles, after their separation from the body, by the touch of a fluid or solid irritable matter, shrink up. The heart of a frog, when touched with the point of a needle, continues to beat, or to contract and expand itself, even some hours after it has been taken out of the body. The heart of a viper or a turtle continues to beat twenty or thirty hours after the death of the animals. But, though this irritability is a power of life, it is certain that these muscles, when separated from the body, can neither have or effect a distinct motion of pleasure or pain. Their regular motions are signs of life, which in many cases may lead us to ascribe the power of life to things that have neither life or sensation. If therefore plants were irritable, it still would

not be a proof of a life peculiar to them. The contraction and expansion of the sensitive plants, and the different motions of leaves, twigs, flowers, and roots, seem to denote such an irritability ; and perhaps all plants possess more or less of this property, if we were to make experiments with the most tender parts of them. Plants therefore have analogy with the animals ; and this analogy, as well as the difficulty in determining the limits of both kingdoms, are the result of their organization. If the organic structure in the different kinds of plants and animals is extremely diversified, still it proves, that the Creator in the creating of both has followed the same universal plan. But perhaps the vegetable kingdom is not so inanimate as we may think. The plant indeed is not capable of feeling pain or pleasure ; but as many of their motions cannot be explained by mere mechanism, they perhaps are the effect of the power of irritability, or the lower power of sensation, which produces the involuntary motions of the animals. We have observed, that in the hot-houses even, plants sleep at night, that therefore heat alone cannot be the cause of their remaining awake. Yet they are deprived of light. But should we place an artificial light over them, with-

out augmenting the heat, and should we then find that the plants would not wake, but continue their sleep as usual, it would be a strong presumption that their organs, as in animals, are not only irritable, but are also in need of a stimulating power of life, which they had lost, whilst awake, by the influence of the air, or the sun-beams, by their action of growing or by some other unknown cause.

The transition from the animal kingdom to that of the plants goes through shades so imperceptible, as to puzzle the most active observer. But in the structure of the plant and the stone there is such a difference as may be the source of many discoveries. In bodies merely stony we cannot observe the least trace of organization. The fibrous structure of the asbestos has been considered as approaching organization, and as the chain which unites the mineral kingdom with that of the plants. But it is a forced and a far looked for analogy. The threads and fibers of the asbetos are neither formed like canes nor interwoven like a net-work, whereby we distinguish organized matter from raw materials. Consequently the bulk of the asbetos can only be augmented by an addition of new matter, but not

by the unfolding and expansion of its parts. Growth, presupposes organization; and the stone does not possess that quality. But though the Creator has not thought fit to organize the kingdom of stones, he has continued to order and regulate it.

The regular form of the salts, crystals and other precious stones, has by some been considered as the result of organization. But their uniform figure may also be the effect of certain laws of attraction, which are peculiar to every species. Neither of their parts can be considered as a germ or a bud. They are only elements or first parts, which by connection form a whole. They become larger but do not grow like the embryos of animals and plants. They remain in the same situation, without being augmented or diminished, except when they are torn asunder by force, or become larger by the addition of new matter. The fluid of crystals is not prepared by organs, but by a chymical process of nature. Whereas on the contrary the bodies of plants and animals are machines ingeniously built and interwoven, which by means of their organs convert other animals and plants into their own being. By this analogy their parts become enlarged

in every direction, and retain their relative situation, in order to fulfil their proper parts. Besides, they propagate, and some possess the power to replace or re-engender such parts as have by force been torn from them.

In those and other properties, peculiar to plants and animals, we find not the least analogy with the kingdom of stones. The difference or distance between the most regular salts and crystals, and the most imperfect animals, is immense. Well formed stones are no more organized than a pillar or a vaulted passage. Nature formed the one, and the master-builder the other. In the raw and more irregular parts of inanimate matter, we find still less proportion; those irregular masses of disproportioned matter seem to be thrown down and heaped up merely as ballast for the equilibrium of the earth. In the formation of metals, indeed, there is more art and design, but their structure bears no trace of organization.

ANALOGY BETWEEN PLANTS AND ANIMALS IS TO BE FOUND, PARTLY IN THEIR STRUCTURE AND ORGANS, PARTLY IN THEIR GROWTH AND NURTURE, PARTLY IN THEIR PROPAGATION AND DEATH.

WE shall not enter any further into the description of the structure of animals and plants. Whoever has any knowledge of plants or the art of dissection, will be acquainted with the essential parts of the structure of an animal or a tree, and he that has not that knowledge, must dissect a human being, an animal, a bird; must kill a fish and gut it; must saw a tree in pieces; or must see a flower, a shrub dissected, where by a short instruction he will learn more than by the most ample descriptions. So much only we will adduce here, as is sufficient to convince us that the Creator, in the structure of all organized bodies, has acted from principle and design.

Men, quadrupeds, birds, fishes, &c. some particularities excepted, are alike in their organic structure. In the form and structure of insects only there seems to be an exception

from the general plan. But by close observation we find even in them the same wise means for the same object. Some insects, and all the shell animals, have their bones on the outside of their bodies: some tribes have no bones, but their bodies consist of a series of intermixed rings, whereby their motion is produced. Many have no eyes, ears, brains, or heart; but this defect is replaced by something else, and nature descends in an imperceptible gradation of perfection in the structure of animals, from man to the polypus, a creature which has excited the surprise of all natural philosophers since the nearer discovery of its properties by Mr. Trembley. The structure of the polypus, who inhabits wet ditches and swamps, is very simple. His body consists in a reed with long arms, by means of which he catches small worms and conducts them to his mouth. He has no proper head, heart, stomach, or intestines. This simplicity of structure is the natural cause of the simplicity in the occupations of the animal. The polypus is of neither sex, yet it is extremely prolific. • If it propagates, we perceive on the surface of its body a small swelling or a germ, which contains the animal in embryo, which, like the twig of the plant, hangs on its mother. The young polypus

receives its nourishment from the mother by means of an apperture, which closes slowly, when it grows to a certain ripeness. It then separates, or falls off, and grows and propagates in the same manner. As every part of the polypus can shoot out twigs, such twigs often appear already on the young ones, and the old polypus bears several generations. If it is cut to pieces in all possible directions, every piece continues to live, and in a short time becomes an animal of itself. If it is inverted, as we do the fingers of a glove, it remains the same animal and continues its occupations. Therefore, what destroys other animals, serves the polypus to multiply itself. Several parts of the polypus may be engrafted upon another, even the head. If the tail of a polypus is engrafted upon the belly of an other, their heads unite and form one animal. Mr. Trembley followed his fancy freely, and formed by means of engrafting, such many-headed monsters as by the wildest imagination never were produced.

A certain texture in animals and plants is the foundation of their structure and occupations. In men and quadrupeds the juices are put in circulation by the pulsation of the heart and the arteries, and in plants they are con-

veyed, by means of the organs of suction, to the stem, branches, leaves, flowers and fruits. The secretion of the different juices in animals, is performed by the glands ; and so in plants the organs perform the same operation. Whatever may be, the power which in plants propels the juices, which is their blood, it is in its operation similar to that of the heart and the arteries in animals. It is indeed no proper circulation ; it is more like the rising and falling of the mercury in a thermometer, according to the degree of heat or cold. But there are insects, like the tape-worm, the polypus, where we cannot observe the least trace of circulation. The internal and most central substance of the plants has some analogy with the brains and the marrow in the bones of animals. What the lungs are in the latter, the leaves are to the former. If a tree in summer time is deprived of its leaves, its roots cannot get ripe ; for the superfluous sap conveyed by the roots, cannot be propelled, and a stagnation or decay is the consequence.

Plants perspire not only by the leaves but also by the rinds of the stem. By means of perspiration they not only throw out certain pernicious juices, but they also inhale from the

atmosphere and the sun-beams some unknown matter, which is necessary for their duration. The lungs of animals do the same. The round bones of animals consist of layers which can be stripped off. The wood of the plants is formed in the same manner. A tree receives every year a new ring, and by counting the number of these rings we can ascertain its age. Something similar to arms we find in plants which encircle poles or trees, or attach themselves with small hooks to solid bodies ; such as the vine, the ivy, &c. The twigs of trees serve partly for beauty and to afford shade, partly for the nourishment of the tree ; as the leaves, exposed to the sun and air, effect a greater degree of exhalation and inhalation. If this analogy between the larger animals and trees does not extend to the grass kinds, which contain mere reeds, yet the latter have great analogy with the polypus, and the knots and woody parts of the grass ; and stocks are to them what the external hard covering is to the shell-fish. The juicy plants, such as leech, sponges, and some sea plants, consist chiefly of a loose substance and may be squeezed into a jelly. The structure of the worms, caterpillars, and the soft insects, has great analogy with those plants.

With respect to the *growth* and *nurture*, the analogy between animals and plants is still greater. Animals, like plants, each in their nature expand slowly from an embryo and arrive at maturity sooner or later. This expansion and increase of substance is the idea connected with the word *growth*. Without real matter, which by the operation of the organs is received into and incorporated with the body, there cannot exist growth. Humidity is the chief *nurture* of plants. But the nurture of plants varies according to their species. Hence it was inferred, that every plant receives from the earth itself every nourishment peculiar to its nature. But it was found by experiments that plants grow and become strong without exhausting any remarkable part of the earth in which they are planted. The structure and texture of plants, indeed, is more simple than that of animals. But nature observes in point of nutrition the same course. Before the victuals of the animal can become nourishing it must be digested, converted into chyle and into blood, from which afterwards all the juices of nutrition are drawn. Here the analogy is striking. Humidity is to plants what the blood is to animals : both derive their nourishment from

the same source, which by the motion of the organs becomes prepared into the different juices, adapted to their different natures.

When growth commences, the embryo of the plant and of the animal is in the same situation. Soon after conception, the fruit is enclosed by skinny substance, and is nourished by blood which it receives from the mother. In the same manner the germ of the plant is enclosed, and its roots shoot out on all sides. When, after sowing, vegetation commences, it is nourished by juices which the seeds receive from the earth and convey them to the small reeds of the roots. In many plants, such as beans, &c. the two side leaves of the seed rise above the ground and cover the young germ, till it is strong enough to bear the air and the influence of the weather. Such a plant, therefore, has two roots; the one in the ground, the other in the side leaves of the mother seed. Here also we observe the same nourishment of the young plant, as the young tender animal receives from milk.

Plants, like animals, grow slowly to ripeness, and to a state of maturity, which according to

the different kinds is affected in some sooner, in some later. Some animals live but a few months. Many insect tribes are born, grow to maturity, multiply and die in the same season : others live two years. The hare lives seven or eight years ; the bear from twenty to five and twenty ; the camel fifty : the rhinoceros seventy or eighty ; the elephant two hundred years ; and some birds and fishes probably from three to four hundred years. The same gradation of age we find in the plants : many herbs last one, two, three years, and some an hundred : and the oak, like the elephant, ornaments the forest for some centuries.

Even the manner of inhaling nurture is nearly the same in both ; in the animal it is performed by the milky organs with which the internal surface of the stomach and the intestines is covered ; in plants the same operation takes place by the organs of the roots and the leaves. Therefore, animals are organised beings, whose roots are placed inwardly, and plants, such as have their roots outwardly, to inhale nutritious juices. Many plants grow in warm climates only, and many, especially the grass kinds, in all climates. The elephant, the rhinoceros, the camel, inhabit warm climates

only; the rein-deer, the glutton, only cold climes; and men can inhabit them all. Trees have to nourish moss and smaller plants, and the larger animals have their insects. Plants, like animals, require motion to promote their growth, and especially fresh air; and some parts of the animals, such as the hair, nails, horns, &c. are of vegetable texture.

Lastly, we have to observe some analogies between the animal and the plant with respect to *propagation* and *death*. Some animals bring their offspring into the world alive; others lay eggs, from which the young ones are hatched. But much as this division encompasses, it is nevertheless not perfect; since animals have been discovered who follow neither of these modes of propagation, such as the polypus, or others, who unite both. The small infusion animals propagate by separation, of which Bonnet gives a description in the *Philosophical Palingenesia*. In former times they had but little knowledge of insects; most of them were thought to be produced by putrefaction. Redi was the first who directed the attention of the natural philosophers to the smallest creatures of the animal kingdom. After him appeared Reaumur, Bonnet, Trembley, Ellis, Spalan-

zani, and other great men, who investigated the effects of nature in the smallest creatures, and discovered new worlds of living beings. Bonnet in his researches discovered, that a species of earth-louse multiplies without the pairing of the sexes. But animals, whether born alive or produced by hatching, come from an egg, with which the seed of the plant in its internal form and its developement has great analogy. The egg requires heat and the pairing of the sexes, the seed requires humidity, warmth, and earth. The former is enveloped in a shell, in different skins, and some white matter, in which the dodder swims, and even this is surrounded by different tender skins. If we do not perceive in plants an analogy with those animals that bring forth their offspring alive, we ought to observe, that the buds or eyes in plants are as many children which shoot out from the mother plant. The potatoe shoots twigs, leaves, and even small potatoes, above the surface of the earth ; and plants of the onion kind contain already, during the winter season, the plants which during spring or summer they push forth. Many plants multiply by inoculation, or by their parts being separated ; and so does the polypus. Every tribe of the animals have their seasons ; and almost in every month, in each

week in the year, different insects are produced: and so the whole vegetable kingdom has its seasons throughout the year. In this beautiful and useful order of nature, the admirable wisdom of the Creator appears, and forcibly strikes the human mind. Should all the plants grow and come to ripeness at one and the same time, they would stagnate or suffocate each other. The earth, however, is constantly to be covered with plants, yet care is taken that certain tribes decay at their proper time, in order to make room for others. Should all the different animals and insects come into being at one and the same time, the air would swarm with pernicious animals, and men could not live, nor the insects themselves, if they were to appear at one and the same time; as the plants destined for their use would not have been grown. In Lapland, where the summer heat is but of short duration, and where the summer insects appear and decay within a few weeks, they feel this nuisance in a high degree. Yet every natural evil carries along with it some good. The rein-deers, who to the Laplanders afford their main food, in order to avoid those swarms of pernicious insects, leave the vallies and flee to the mountains, whither those vermin, on account of the cold, do not

follow them, and from whence they do not return to the vallies, till those myriads of insects are killed. This migration is of double advantage. It preserves the health of the reindeer in the mountains, and preserves their means of nourishment in the vallies, which otherwise would be consumed before their time.

At last we have to observe the only melancholy analogy of both these kingdoms, which is their decay and death. It is an unalterable and wise law in nature, that all organized bodies are constantly approaching dissolution. But the duration of life differs. Previous to death, animals and plants are subject to similar diseases. Too great a degree of heat and cold, want or superfluity in nourishment and motion, has on both the same influence. The plant droops its head and looks sickly, if it is in want of earth, of air, and humidity; and the animal cannot live in similar situations. Different kinds are subject to the influence of different accidents. Leaves, blossoms, fruits, germs, rinds, have their peculiar diseases and pernicious insects: they, the same as animals, if the wound is not mortal, are assisted by nature and art. At last old age ap-

proaches, and with it its companions, decay and death. The organs become hard and inflexible ; the fluids do not circulate as rapid as in the state of growthfulness ; they stagnate, and the plant goes to decay. And so in animals does infancy, youth, puberty, weakness, beauty, fruitfulness, and decline, succeed in different gradations. And what else is man but a plant ? He is engendered, is born, grows to maturity, blossoms, bears fruits, decays, and dies. Weak and tender in infancy, beautiful and strong in youth, firm and fruitful in manhood, cold and relaxed in old age ! Some decay like rose buds, before they bloom up ; others die like old aged oak trees. The head bends down, the sources of life dry up, and plants and animals return to the dust whence they had originated. The soul only survives these changes of matter !

ON THE MECHANICAL AND CORPOREAL STRUCTURE OF THE ANIMAL KINGDOM.

THE structure of the human body, in its internal and external parts, is a master-piece, of divine omnipotence and wisdom, is the pattern of animated bodies, and in this respect distinguishes man from the other animals by many advantages. It is the business of anatomy to make us acquainted with that structure. From the instructions at a dissection of a body, we derive more knowledge than from a dry description of the names of every part.

The bones form the firm parts ; and a skeleton in its connection is so wisely arranged, that Galen, by an attentive observation of the whole, was from an atheist converted into an admirer of God. To the bones belong the cranium, back bone, ribs, arms, and legs. The fleshy parts consist in muscles, which are serviceable to animal motion by their contraction or expansion. The heart is the general receptacle of the blood, which by the contraction of the heart is propelled through the arteries. The lungs, which consist of innumerable ducts, serve for

respiration, which is necessary for the existence and continuance of life in man and beast. The stomach serves for the digestion of the victuals, and absorbs the nutritious parts of the aliment ; rejecting all the grosser and useless particles. In its operation, it secretes particular juices, whereby the aliments are dissolved, and converted into chyle, which is a mild fluid, circulated through the body by other organs, to replace the lost strength. Those organs whereby we multiply our species, deserve, without any false shame, to be considered with admiration, as a work of the utmost creative wisdom ; and perhaps youth would offend the laws of nature less, if as soon as they are capable of forming ideas, they were instructed of their nature and destination. It would be worthy the attention and trouble of a tutor, to compose for youth a proper description of those wonderful parts.

The brain of human beings is, comparatively speaking, much larger than in other animals. From the brain and spinal marrow proceed, according to observation and experience, all the nerves or instruments of sensation either for pleasure or pain. These nerves, the ramifications of which are infinitely various and min-

ute, are distributed throughout the body. But how this is performed is yet a secret. Some consider the operation to be effected by means of threads or fibers set in motion by a species of electricity; some take the operation to be performed by small canals and ducts, which by their fluidity convey sensation to the soul. But it is doubtful whether in fifty dark and intricate cases, we shall ever arrive at the true light.

It is remarkable, that the mental faculties of the lower animals are stronger or weaker in proportion as their form and structure resembles the human body more or less. Quadrupeds have more faculties than birds; birds more than fishes; fishes more than most part of the insects. The ourang-outang in its structure bears the nearest resemblance to the human form, and the artful manner with which he acts and defends himself, betrays so much wit, that some philosophers have considered him as a human being of the lowest grade. After him, the monkeys have the most resemblance to human beings; and their actions have at all times not only contributed to the amusement of men, but have excited their astonishment.

All the quadrupeds, though there is a great diversity in their structure, are formed according to one plan and model. The skeletons of all animals, from man to the mouse, have a certain resemblance ; yet the Creator has in every possible manner diversified the only great thought of the creation of animals, and expressed it in ways so various that reasonable beings have an opportunity of admiring the simplicity of the plan, as well as the diversity and greatness of the execution. The organs of sensation, digestion, motion, and propagation, are almost alike in all. In the covering of animals there exists great diversity. Those animals who do not possess the capacity of making garments for themselves, are provided with a woolly or hairy covering, which, with respect to thickness and warmth regulates itself according to the season or climate. In Russia, Lapland, Kamschatka, and other northern parts, the furs are thick and warm ; in Turkey, Asia, and the southern parts, they are thin ; and the Turkish dogs have no hair at all.

The variation in the organs of digestion is accompanied with great diversities in food, dispositions, and manners of the animals. Some feed upon flesh, others upon vegetables, and

others upon a mixture of both. In all carnivorous animals, as those that live solèly upon flesh, the stomach and intestines are shorter, in order to reduce the food sooner into chyle, and promote the juices of the other parts of the body ; besides they are, as the lion, the tyger, the cats, furnished with sharp teeth and claws for seizing and devouring their prey. The quick digestion is a consequence of the shortness of their intestines, and the cravings of their appetite create fierceness and rapacity. Nothing less than blood can satiate them. The devastation they make among the weaker tribes, are effects resulting solely from their structure and organs, and they are therefore component parts of the plan of nature, for the use of the whole.

In the herbivorous tribes, or those animals which feed upon herbage and grain, the intestines are long and capacious. Some have no less than four stomachs, and ruminate or chew the cud. The quantity with them, compensates the quality of the nutriment, and can be retained in the bowels longer than flesh, which soon turns to putrefication. The horse, the ass, the hare, and some others, have but one stomach, but their intestines are furnished with

sacks so large that they may be compared to ruminating animals. Besides, their necks are long enough to bend their heads to the ground for the operation of browsing herbage. They have no cutting teeth nor claws, which shews that they are not intended to prey upon other animals. From all this, it is evident that animals of this description must be humble, mild, and submissive in their dispositions ; and man has availed himself of those dispositions by reducing almost the whole of this tribe to a domestic state. Their tractability of temper, is the natural and necessary result of the structure of their organs ; and the harmless disposition of the sheep and the ox, is in them no more merit than the fierceness of the tyger and the hyæna is a demerit.

Man evidently is destined to live upon flesh as well as upon bread, herbage, and fruit. He certainly can subsist upon vegetables alone, as is proved by the Hindoos and other nations, who are prohibited by their religion to kill or eat any animal substance. But these examples are not sufficient to convince us, that thereby the vigour, health, and multiplication, would be improved. Experience teaches us, that men

who live upon animal food are stronger, more lively, courageous, and prolific, than those who are confined to a vegetable diet : and this has great influence even upon their disposition and manners. As man, from the structure of his intestines, is to live upon flesh as well as vegetables, and is therefore the medium between those of the carnivorous and herbivorous tribes, his disposition ought to be neither choleric and cruel, nor cringing and submissive. The advantage man has in his structure over other animals is evident : his body is erect, his height and air distinguish him, and his attitude is that of command. There is a certain majesty in his looks and deportment. His arms are not mere pillars for the support of his body, and his hands tread not the earth, neither do they loose by friction and pressure that delicacy of feeling for which nature intended them. He executes with them the commands of his will, lays hold of bodies, removes obstacles, defends himself from injury, and seizes objects of pleasure. If some animals derive equal advantages in this respect ; if others surpass men even in the swiftness and strength of some organs ; the great source of man's superiority over the brute creation is derived from his mental faculties. He compensates the want or

weakness of hearing, of the eye-sight, by artful inventions ; converts the earth into a more pleasing form ; builds his habitations, not like the bee and the beaver, with invariable sameness, the effect of an irresistible instinct, but by design and taste ; he forms ideas, compares his feelings, reasons and draws conclusions ; he discovers unknown truths, invents instruments, continues them by writings to posterity, and reaches all the heights of science and of art.

We have yet to observe some particularities in the structure of some animals according to their destination and use. The camel and dromedary have, besides the four stomachs common to ruminating animals, a bag which serves them as a reservoir for holding water, whereby they are enabled to travel, six, eight, or even twelve days, in sandy deserts, without drinking ; and to take at once a prodigious quantity of water, which remains in the reservoir pure and limpid. When the camel is thirsty, he makes part of this water, by a simple contraction of certain muscles, ascend into his stomach and gullet. With incredible submission, they lay down upon their knees till the heavy load they have to carry is fastened upon their backs. It is an animal nicely adapted to the soil and

climate in which they are produced ; that is, for the desarts of Africa and Arabia. The Arabians eat their flesh, drink their milk, and of their hair make their garments. They therefore consider it as a sacred animal, a particular gift of heaven. An Arab, by the assistance of his camel, robs his neighbours, eludes their pursuit, and carries off with impunity all that he ravages from them. In possession of their camels, the Arabs have no notion of want or fear : all the armies in the world would perish in pursuit of a troop of Arabs.

The heart of amphibious animals, who can live both upon land and in the water, is so constructed that the circulation of their blood takes its course according to their destination, and that they respire at their pleasure. The seal holds dominion of the silent ocean : his voice, his figure, his seeming understanding, give him that preference : he is docile, social, and loves his female companion and his offspring, which is evident from his tender attention, and the expressive modulation of his voice : he is neither afraid of cold nor of heat : he inhabits water, land, or ice ; lives on herbs, flesh, or fish ; forms societies ; and if necessary they assist one another.

The structure of the elephant is as uncommon as his talents are rare: he is the largest and most magnificent animal that at present treads the earth: he daily devours great quantities of herbage, leaves, and branches of trees; and as he has but one stomach, and does not ruminate, this want is supplied by the magnitude and length of his intestines: his eyes are small, but they are lively, clear, and full of expression: he listens to the orders of his master with friendly attention, and executes them without passion or precipitation: his long ears he can raise and move with facility, and with them defend his eyes against dust and insects: his ear is so musical that he moves in cadence to the trumpet and tabor. But of all the organs given to animals, the trunk of the elephant is the most perfect and remarkable: it is composed of different organs both of feeling and of motion; and though the body is plump and unwieldy, peculiar to the elephant only, yet he has the advantage of that trunk or proboscis, which he can move, bend, contract, lengthen, and turn on all sides, and with which he can examine every object. The extremity of the trunk terminates in the form of a finger; by means of which he can lift from the ground the smallest piece of money, can select and pick

up herbs and flowers, untie knots of ropes, open gates by turning the keys or pushing back the bolts. In the middle of this finger, there is a cavity in the form of a cup, at the bottom of which are the organs of smelling and respiration.

The structure of the feathered tribes is nicely adapted to the element in which they move. Instead of hairs, their bodies are covered with feathers, which, beside the beautiful variety of their colours, protect them from the assaults of rain and cold. They have but two legs ; but they are furnished with two additional instruments of motion, their wings, by which they are enabled to rise from the surface of the earth, and to fly with rapidity through the air ; which motions are performed by muscles of remarkable strength. In order to guard those, who are continually passing through hedges and thickets, from injuring their eyes, as well as from too much light when flying in opposition to the rays of the sun, they are furnished with a membrane, which, like a curtain, the birds can draw at pleasure, over their eyes, and which covering is transparent enough to enable them to direct their progress through the air. By the instrumentality of this membrane

the eagle looks at the sun. The feathers of all birds lay backward from the head, that the rain may run off their bodies, and prevent the wind when flying against it, from rumpling their feathers and retarding their flight. If their feathers are too dry, or in disorder, they draw with their bills an oily substance from a gleet on the rump, with which they besmear and dress the feathers, and prevent thereby the admission of water. With their wings they move through the air, and their tails serve them as a rudder to direct their course. Their breastbone is not flat but terminates in a sharp ridge, or keel, like that of a boat or a ship, which enables them to cut the air with greater facility. For the same purpose, the heads of birds are small and their beaks sharp pointed. From their whole structure it is apparent, that they are created, either to walk and to live on the surface of the earth, or to penetrate the airy regions.

But in the structure of birds even we find some peculiarities. Like quadrupeds they are divided into carnivorous and granivorous : the intestines and stomachs of the latter, like those of the herbivorous quadrupeds, are proportionally larger, and much larger than those of the

carnivorous birds; therefore the structure of granivorous birds and the herbivorous quadrupeds is analogous, and the quality of their food is very similar. This analogy extends even to their manners and dispositions: they distinguish themselves by the gentleness and complacency of their tempers. Contented with the seeds of plants, or small insects, the stronger never wage war with the weaker: they are solely occupied in procuring food, in hatching and rearing their young, and in guarding against the rapacity of men and other animals: they are tame and timid, and may easily be rendered domestic. Man, ever attentive to his interest, takes care to derive advantage from the innocence and stupidity of these animals: he has selected those kinds which are the most prolific, and consequently most profitable, viz. the hen, the goose, the duck, the turkey, and the peacock. These birds are polygamous, one male being sufficient to fertilize a number of females, which is a great saving in the article of food.

Carnivorous birds have weaker stomachs and shorter intestines; they fly quick, and continue long on the wing; their wings are longer, and they have more strength in their muscles;

they have hooked bills, long sharp claws, large heads, short necks, strong thighs, and sharp sighted eyes, which are all organs given them by nature for the purpose of seizing and devouring prey. They are capable of enduring hunger for a great length of time, because the obtaining of their food is often very precarious. The females are larger, stronger, and more beautiful than the males; and this superiority of size and strength seems to have been bestowed upon them by nature, because they are obliged to procure food both for themselves and their progeny. The weapons with which they are provided, indicate, like those of carnivorous animals, destruction and rapine. They never herd together in flocks, the vulture excepted, but conceal themselves in sullen solitude on the tops of rocks, or in the depths of the forests, where they watch for their prey. Ravens and others, who feed upon carion, have the sense of smelling so acute, that they scent dead carcasses at amazing distances.

Like the amphibious animals, a number of the bird kind live chiefly in the water, and feed upon fishes and aquatic insects. To enable them to swim and dive in quest of food, their

toes are connected together by broad membranes or webs, which they expand, and with which they move their bodies forward. When restrained from their favorite element, and when their liberty is restored, they fly in a direct course either to the sea, a river, or lake. Another tribe of aquatic birds, who feed upon fishes and insects, or live by sucking certain juices from mud, frequent marshy places or the margins of lakes and rivers. They cannot swim, but wade in quest of food. For this purpose nature has provided them with long legs, naked of feathers for a considerable space above the knees. Their toes are not, like those of the swimmers, connected by continued membraneous webs; but most of them have very long necks and bills, to enable them to search for and apprehend their food. To these tribes belong the crane, the stork, the snipe, and many others.

According to the intention of nature, no part of the universe is deprived of inhabitants: the waters, therefore, are full of living beings, who by their structure and form are destined to live in that element. Some fishes are long and cylindrical, some short, some broad and compressed; others are round, triangular, quadran-

gular, and some flat. The ocean contains the largest animals. The whale is larger than the elephant. From the immense bones, however, found in Siberia, we are induced to believe, that land-animals have formerly existed, whose size must have been much larger than that of the elephant.* The fishes live upon other fishes. The swimming bladder enables them, by contraction or dilation, to render their bodies heavier than water, and sink to the bottom; or to make their bodies lighter, in order to rise to the surface.

The number and variety of insects is immense. Their *antennæ*, or feelers, enable them to examine the substances they meet with; and, as they can see distinctly but at small distances, these feelers supply the want of eyes. All winged insects undergo three metamorphoses, or changes of form: the egg is discharged from the body of the female in the same manner as in other oviparous animals: by instinct they deposit their eggs on

* Near the river Ohio, and some other parts of North-America, some prodigious bones and teeth have been discovered, which indicate an animal of incredible magnitude. It is known among naturalists by the denomination of the Mammoth.

such animal or vegetable substances as furnish proper food for the worm or caterpillar, that is to be hatched by the heat of the sun. The worm, or caterpillar is the first state ; and their bodies are soft and moist: they have no wings and no faculty of generation. After continuing for some time in this reptile state, they are transformed into a chrysalis, which is drier and harder than the caterpillar. The chrysales of some insects are naked, others are covered with a silken web, spun by the animals before their change is completed : in this state many of them lie motionless and seemingly inanimate during the whole winter. When the spring or summer heats return, they burst from this last prison, and, from wild reptiles, are transformed into beautiful flies. In this state they are active, fly about in quest of their mates, and after propagating their species the same change perpetually goes round.

The republic of the bees is well known : their structure and their instinct, as in the ant, the spider, and every other animal and insect, coincide with their destination. In all the variety of animated beings we perceive that their bodily forms are exactly adapted to the rank they hold in the creation, and that their economy

and manners are strictly connected with their structure and organs. Should a new animal appear, and its figure be uncommon, we may safely pronounce its manners equally uncommon. Change the external or internal form of an animal; give to the ruminating animals a stomach less; or give to the horse a parrot's bill, and the species will be annihilated.... A certain proof, that in the creation the final objects are obtained by appropriate means!

It is not the external strength and magnitude of the organs, but the mental faculties, or the capacity of receiving instruction, that afford the greatest sources of animal power: hence man's unlimited empire over the earth, and all other visible beings. The invention of language, of arms, of writing, printing, engraving, and other arts and sciences, have been the chief means of his acquiring and securing the dominion of the earth. By these means the dispositions of men are softened; their strength is more cultivated; and if the feelings themselves be not blunted, their manners become more and more civilized; and in social life the grosser animosities yield to external politeness. It is impossible to determine, how far this pro-

gress of science and the peaceful arts of life may proceed by the accumulation of ages. But the time, it is hoped, is not very remote, when venality and selfishness, which seem to be inseparable from commercial states, will give way to disinterested humanity, and that the yet reigning ferocity will be dispelled by nobleness of mind, justice, and truth.

OF THE RESPIRATION OF ANIMALS, AND THE
VARIOUS MODIFICATIONS OF THE ORGANS
FOR THE TRANSMISSION OF AIR INTO ANI-
MAL BODIES.

THE respiration of air is indispensable to the existence of all animals, from the largest to the smallest. The experiments that have been made upon animals with the air-pump, have given sufficient proofs of it. If a mouse, a rat, &c. are placed in an exhausted reservoir, they become restless, betray pains, their bodies swell, and life soon becomes extinguished. Even plants and flowers become relaxed, weak, and sickly, if the air is by the air-pump drawn out of them. In man, and all the larger land-animals, air is taken into the body by the lungs: and though with this operation the motion of the heart and the vital warmth is closely connected, this connection has as yet remained inexplicable. The circulation of the blood is thereby promoted, or stopped, if the air, either by sulphurous exhalation, or by water, is excluded: but in many cases the motion of the heart has been retarded by infusing the lungs with air, and rubbing different limbs with irritable matters. The Humane Society of Lon-

don, for the recovery of suffocated or drowned persons, has for that purpose pointed out the best and most simple methods. As soon as in persons who are seemingly dead the lungs can be excited to act, the motion of the heart, the circulation of the blood, and that of life itself, returns.

By the lungs many corrupted vapours are exhaled ; and besides, the organs of respiration are in immediate connection with the organs of speech ; to which belong the tongue, the lips, the jaws, the teeth, the whole palate, the nose, the throat, together with the muscles, bones, &c. The power of speech, or the expression of pleasure by laughing, or pain by weeping, is peculiar to man ; though we find something similar in the inarticulate cries and sounds of animals.

Birds, like other land-animals, respire by means of the lungs ; but nature has enabled them to transmit air to almost every part of their bodies. That ingenious and accurate anatomist, Mr. John Hunter, of London, made an experiment. He made an opening into the belly of a cock, introduced a silver cancela, tied up the brachea, and found that the

animal breathed by this opening. He made a similar opening in another fowl, by cutting the wing through the os humeri, and found the same effect: from which he inferred, that these air-cells have by nature been given to the birds, with the wise intention to assist the act of flying. For, the resistance of the air encreases in proportion to the rapidity of the motion.

This structure encreases the strength of birds, and makes them lighter. But, were it possible for man to move with a swiftness equal to that of a swallow, the resistance of the air would soon suffocate him, as his structure is different from those of birds. The ostrich is formed like other birds, and though he does not fly, he runs with astonishing rapidity.

Even to the fishes in the water, the respiration of air is necessary; and they are, like other animals, provided with organs for that purpose. *Ælian* informs us, that in winter, when the river *Ister* was frozen, the fishers cut holes in the ice; that great numbers of fishes resorted to these holes; and that their eagerness to respire air was so great, that they allow-

ed themselves to be seized by the hands of the fishermen. Put fishes into a narrow mouthed vessel filled with water, leave it uncovered, and the animals will live and swim about; but if the mouth of the vessel be shut, either with the hand or any other covering, they must die, after they, in vain, have crowded to the top, contending which of them shall soonest receive the benefit of the air. In shallow parts of rivers, when frozen, many fishes are found dead: but in deep or rapid rivers they fly from the ice and avoid destruction. A carp, placed in a vessel full of water, in the receiver of an air-pump, will, after being deprived of air, sink to the bottom, and expire in convulsions.

Nature has for the insects and other noxious worms also employed modes for transmitting air into their bodies. They have indeed no lungs; but their bodies are provided with trachæ, or wind-pipes, which serve for the same purpose. That the small holes which run along the sides of many caterpillars in regular and beautifully doted lines, are destined for the transmission of air, has been proved by repeated experiments, especially by M. de Reaumer; and even in their state of transform-

ation, when life in them seems to be extinguished, the spark of vital power is, by the introduction of the air, preserved.

Experience, however, teaches us that some animals can live longer than others without the use of this element, or at least with smaller quantities of it. Men, by long practice, may acquire the faculty of retaining the air in their lungs for an almost incredible length of time. Some of those wretched creatures who are compelled by tyranny and rapacity to dive for pearl visters, have been known to continue under water three quarters of an hour without recieving a fresh supply of air, though many of them have thereby found their grave. Those animals which lie torpid during the winter, exist without any apparent breathing, till the spring and summer restores their wonted powers of life.

At the approach of winter, the toad retires to the hollow root of a tree, to the cleft of a rock, and sometimes to the bottom of a ditch or pond, where it remains for months in a state of seeming insensibility. Still the principle of life is continued, and the animal revives in the spring. What is more wonderful, toads have

been found a hundred paces below the earth, inclosed in the heart of solid rocks, and in the bodies of trees; even in the midst of marble, where they are supposed to exist for centuries, without any apparent access either to nourishment or to air; and yet they were alive and vigorous. In the many examples of toads found in solid rocks, exact impressions of the animals' bodies, corresponding with their respective sizes, were uniformly left in the trees, stones, or marble. It is difficult to explain this circumstance: the toad, however, is an animal belonging to those tribes that can exist several months without receiving any portion of food, but are the more voracious when they meet with it: in its state of natural liberty, it devours voraciously spiders, maggots, ants, and other insects. But it is as difficult for us to conceive an abstinence for months, as one of as many years or even centuries. The one fact, therefore, may be as readily admitted as the others. Besides, almost all those facts have been discovered by common labourers, who are totally unqualified for examining every circumstance with the discerning eye of a philosopher. In rocks, as well as in old trees, there are many chinks, fissures, holes, and vacuities, through which the eggs of toads may accidentally be con-

veyed by water, and there hatched and nourished. Perhaps, by a strict observation of every circumstance, light in future may be thrown upon a subject so dark and mysterious.

As the air we constantly breathe is liable to be impregnated with exhalations from every substance, and is therefore as liable to become pernicious, personal as well as domestic cleanliness becomes one of the first duties. In building towns, houses, or hospitals, the situation, with regard to air, is a capital object. The vicinity of marshes, of stagnated waters, of manufactures of tallow, or oil, the smelting or corroding of metals of every kind, and many operations which contaminate the air, should be either avoided or removed. Burying grounds should never be suffered within the compass of a city: they should be in open fields, in free air. Even in northern climates, houses surrounded with trees, or in the neighbourhood of luxuriant vegetables, are always damp and infested with insects; and hence the ambient air is replete with the seeds of disease. In hot climates, these precautions are still more necessary. According to the degree of heat, air absorbs a greater or less proportion

of the particles of bodies. It is therefore not surprising if at Madrid, at Constantinople, and other large cities, where the houses are crowded together, the streets narrow, and covered with filth of every kind, pestilential diseases frequently have made their appearance, before they have thought of preventing such disorders by cleanliness and air.

MOTION OF THE ANIMALS.

ALL things on this globe may be divided into two classes : either they consist of those objects endowed with a self-moving power, and with some qualities similar to those of our minds ; or of such objects in which no such qualities appear, and which are of a nature so passive that they never move, but when put in motion by other causes ; nor ever stop till they are arrested by some external influence, or resistance.

The motions of animals are performed by the instrumentality of muscles, tendons, and nerves. But the operation of muscles depends upon some unknown influence from the brain and nerves. Almost all motions are subject to the will and inclinations of the creatures who perform them ; but there are other involuntary motions (*actiones vitales*) such as the action of the heart, the circulation of the blood, the digestion of food, the peristaltic motion of the bowels, the movement of the various secreted liquors, the action of the lungs in respiration, &c. &c. which go on without any conscious exertions of the intellectual principle. If such a

variety of nice and complicated movements had been left to the direction of our minds, they must necessarily have occupied too much of our attention ; and often have been neglected, even so far as to cause an entire stopage of the vital powers, especially during sleep, when consciousness is often almost totally suspended. But, how wise are all the actions of the Creator ! He gave to man no other power of movements but what are easily performed, contribute to pleasure and health, and enable him to acquire and prepare food corresponding to the structure of his body and the element in which he lives. How much wisdom do we not discover in the number, insertion, and direction, of the muscles employed in moving the different parts of animated bodies, whereby they are enabled to walk, leap, fly, swim, creep, &c.

The motions of animals are proportioned to their weight and structure. A flea can leap some hundred times its own length. Were large animals, such as the elephant, the camel, the horse, to leap in the same proportion, their weight would crush them to atoms. The same remark is applicable to spiders, worms, and other insects, who fall unhurt from heights that would destroy heavier animals.

Motion is the cause of the birth, perfection, death, and reproduction, of all animal and vegetable beings; it is the cause of the beautiful diversity and change of all things; it is the soul of the whole creation. The globe we inhabit, and all the innumerable and stupendous heavenly bodies, are constantly in motion. The plains and mountains, rivers and lakes, islands and continents, seas and oceans, all are filled with animated beings, who by their diversities continually solicit our attention, gratify our curiosity, and occupy our reason and reflection. Nothing remains what it is; all are subject to decay, according to the gradation in which nature has placed millions of creatures on this globe; the grandeur of which, however, when compared to the number and magnitude of other heavenly bodies, like a point, vanishes from our sight. Insignificant as man may appear, lost in the boundless regions of the universe, yet he expands his mental faculties, and exalts his ideas of that inconceivable power which first produced those astonishing orbs, and still supports them in their motions. The different motions to which animals are stimulated by the desire of food, by love, by their appetite for frolic and exercise, by their hos-

tilities, and by other exciting causes, give animation and vivacity, life and beauty, to the whole scene of nature. A silent and motionless prospect, however beautiful and variegated, soon ceases to please, and at last becomes insupportable. Let a garden resemble a paradise, and the greatest ornament is wanting if no rivulet meanders through it, or no fountain plays in it. Water is constantly in motion, and motion is the object or cause of all sensation. In music we hear it; in taste we taste it; in odours we smell it; in light we see it; and in touch we feel it.

Certain animals are endowed with a peculiar kind of motion. Such as are furnished with destructive weapons, uncommon strength, or ingenuity, are proportionally slower in their motions than the weaker kinds. Before the crocodile is able to turn itself, we can secure ourselves from danger. Worms, caterpillars, and other insects, whose food is always at hand, are confined to a small compass; but the motion of birds and fishes are extremely rapid, for they have the air and the ocean for their range, have to pass through large tracts in quest of food, and many enemies to avoid. Timid animals, as the hare, the rabbit, and the

Guinea-pig, are, even when they are not in danger, perpetually in motion; they are restless, erect their ears, or raise themselves on their hind-legs, either to catch the scent of food, or to increase the circle of hearing, when afraid. The shell tribes either hang on rocks, by means of certain threads (sometimes called the beards of muscles) or they swim and move in a manner peculiar to their nature. The oyster is possessed of the power of moving and of feeling. The motion of the sea-nettle is as slow as the hour-hand of a clock.

OF THE ORGANS OF SENSATION.

No animal of which we have any knowledge, is endowed with more than the five external senses, of smelling, tasting, hearing, feeling, and seeing; and no animal, however imperfect, is destitute of the whole. Without organs of sensation, in a smaller or greater number, animal or intellectual existence is to us an inconceivable idea. Therefore the notion of the ancients, and of a few moderns, that this earth as well as all the heavenly bodies, are intelligent beings, though we perceive in them no instrument of sensation, and nothing but mechanical motion, is extremely absurd. All sensation is conveyed to the mind by an unknown influence of the nerves. If the instrument of seeing, smelling, or any nerve distributed over an organ of sensation, be cut, the animal instantly loses that particular sense: this is a fact universally established by experiment.

But that the nerves, which are perfectly similar in every part of the body, should, when distributed over the eye, the ear, the tongue, or the nose, convey to the mind feelings so different

(as one and the same juice or fluid proceeding from the earth, produces different colours in the flowers) is the most mysterious part of the subject.

OF SMELLING.

IN man, and many other animals, the nose is the organ of smelling. Its inward membrane is soft and porous, covered with numerous papillæ and olfactory nerves; they are almost naked, and exposed to the action of the air, which through them penetrates to the lungs. In order to defend the nerves from the pernicious part of the air, and acrid odours, nature has furnished the nostrils with a number of glands, which secrete a thick slime that covers those nerves. Nature has wisely placed the organs of smelling and tasting near each other, that they may give mutual aid to one another.... The odours are extremely various: what is delightful to one, is noxious and disgusting to another. Those (and such there are) who delight in lighting and putting out candles, merely to enjoy the smell of it, will not be envied for the singularity of their organs of smelling: but the odour of the rose, and other flowers, is so refreshing and powerful, that it penetrates all the nerves and becomes balsamic.

Brute animals select their food and drink, by employing the sense of smelling. They easily

distinguish noxious from salutary food, and use the latter. A cow always repairs to the clearest and freshest streams, when it can be obtained; but a horse, by some instinctive impulse, raises the mud with his feet, and renders the water impure, before he drinks. And so does man select his food by the sense of smelling: he avoids with abhorrence victuals which have a putrid smell, but he will eat with pleasure substances which have a grateful and savoury odour. But men in society, by the art of cookery, and the mixture of many ingredients, blunt and corrupt their senses of smelling. Brutes are contented with the plain produce of nature. However, constant uniformity would also soon render food insipid to man, if his palate were not stimulated by variety. Domestic animals are nearly in the same condition with their luxurious masters: a pampered lap-dog snuffs at and rejects many kinds of food which he would devour with avidity in a natural state, where hunger is the only seasoning. Every thing in animate and inanimate nature, whether animal, vegetable, or mineral, when exposed to the air, sends forth effluvia of such extreme subtilty that no eye can perceive them; and these effluvia diffuse themselves through the air. The inconceivable minuteness of these

particles may be perceived from this circumstance, that the odour of musk has been known to fill a large space for several years without losing any perceptible part of its weight. The air is perpetually impregnated with an infinity of particles which stimulate the organs of smelling. Some animals, as the dog, the fox, the raven, &c. are endowed with more acute organs of smelling than man: a dog scents various kinds of game at considerable distances, and traces the odour of his master's foot through all the winding streets of a populous city: this extreme sensibility in a dog is incomprehensible to man; but how many disagreeable sensations does he not avoid by the want of this acuteness of smelling! And so we often are happy, not only by what we possess, but also by what we are deprived of.

OF TASTING.

THE tongue and palate are the organs of this sensation, and are situated near the canal whereby the aliments are conveyed to the stomach. The tongue is amply supplied with nerves and minute nipples on its surface, the latter of which are always erected on the application of stimulating substances. The saliva, though insipid, is one great cause of all tastes, and is a very powerful solvent. When the tongue is rendered dry by disease, the sense of taste is either vitiated, or totally annihilated. In one man the sense of tasting is blunt, in another it is acute. The sensation conveyed to the mind by taste, is either agreeable, disagreeable, or indifferent. To the brutes it is a source of the greatest pleasure and utility. This sense itself, comparatively speaking, is gross, and not as sublime as hearing and seeing, which are sensations that can be excited by objects at great distances; whereas in tasting, the object must be brought in actual contact with the tongue. How this gross sense, taste, should have been selected and figuratively applied to the general perception of every thing

beautiful and sublime in nature, it is difficult to determine. Perhaps it would be worth the trouble of inquiring, whether men who have an obtuse sense of tasting material substances are likewise deficient in the perception of beauty and deformity. Brutes follow the dictates of nature and eat and reject the same species of food. But men by habit and art prevent their sense of taste. It is difficult to determine, whence the aversion to particular kinds of food in some persons arises. Perhaps the cause lays in the stomach, produced by surfeits and indigestion.

OF HEARING.

THE mind hears, when by undulation of air the ear is struck, which is an organ of a very delicate and complex structure. The canals to the internal part of the ear are cylindrical, and become gradually smaller, till they reach what is called the drum of the ear, through which, by means of a complex apparatus of bones and nerves, the sound is conveyed to the brain.... The external parts of ears in many quadrupeds are large, so that they can move them from side to side and catch the sound the easier.... The sound is propagated through the air almost in the same manner as the undulations produced by a stone thrown into a pond of stagnated water. These undulations assume the form of circular waves, which successively proceed from the place where the stone struck the water, as from a centre, till they reach the banks of the water, where they either vanish or are reflected. In the same manner the vibrations of sonorous bodies are propagated, till they come into contact with our organs of hearing. This analogy is sufficient to give us an idea of echoes, which are nothing else than reflected undulations of that fluid.

The celerity with which sounds move, has been exactly computed: viz. 1142 feet in a second of time, whether the sound be acute or grave, strong or weak. Hence, whenever the lightning of thunder, or the fire of artillery are seen, their distances may be easily ascertained by the sound that follows. This velocity, it is true, may be a little augmented or diminished by favourable or by contrary winds, and by heat or cold. But the difference is trifling.

Infants hear bluntly, because their organs of hearing are soft and weak; and the tremulations excited in them by the motions of the air are comparatively weak. Hence it is that young children are so extremely fond of noise. They throw every thing under the table merely to be in motion and excite a strong sound. The force of sound depends upon the reflection from surrounding objects. It is from this cause that the human voice, or any other noise, is always more distinctly heard in a house than in the open air.

The modifications of sound are not less various than those of taste or smelling. The ear is capable of distinguishing some hundred tones of sound, whether they proceed from a

violin, a flute, or a French horn. By habit only we learn to know the bodies from which the sounds proceed; for, previous to experience, we could not distinguish whether a sound came from the right or left, from above or below, from a greater or smaller distance. Music, or the melody and harmony of sounds, is to man a great source of pleasure and of innocent amusement. But an ear for music, like a genius for painting or poetry, is a gift of nature, and is born with the possessor; though it is possible that every talent may be highly improved by habit, diligence, and culture.

Besides the natural language peculiar to all men and brutes, there are artificial languages which are produced by a diversity of associations of men who agree to denote certain things by certain articulate sounds. Hence the diversity of languages. And those artificial sounds, and their diversities, contribute in a high degree to the pleasure of man.

OF TOUCH.

ALL the senses have their organs, which are confined to the head ; but the sense of touching, or of feeling, is not only common to these organs, but extends over almost every part of the body. Every sensation, external or internal, is *feeling* ; but what is called the sense of *touch*, is properly restricted to the different sensations excited by bodies applied to the skin, and particularly to the tips of the fingers.

Some external parts of the body are more amply supplied with nerves than others ; as the eyes, the ears, the nostrils, the tongue, the palate, and palms of the hands, especially towards the points of the fingers. The termination of the nerves on the surface of the skin are soft and pulpy, and are obviously the immediate instruments of sensation. The touch of them produces either pain or pleasure, or the insipid medium between both. If an object possessed of agreeable feelings is perceived, the nervous papillæ instantly extend themselves, and from a state of flaccidity become comparatively rigid like bristles. Of this we may convince ourselves by observation and ex-

periment. If we examine any substance in the dark, we perceive a kind of rigidity at the tips of our fingers. And in this manner we may stretch or relax any organ of sensation.

The friction or number of impulses made upon the papillæ, determines the extent of pleasure or pain. Apply the hand to a piece of velvet, and it is merely agreeable, but this agreeable sensation will be augmented by rubbing the hand repeatedly on the surface of the cloth. If we are hungry, the sight of palatable food raises the whole papillæ of our tongues and stomachs, which is the cause of our eating with so much appetite. But if the stomach is less keen, the desire is not so urgent, the victuals less inviting, and therefore the papillæ less erected. It is by this sense that we acquire the ideas of hardness or softness, of heat and cold, of pressure and weight, of figure and of distance. The sense of touch is more uniform, and liable to fewer deceptions, than the other organs of sensation; for the bodies themselves must be brought into actual contact with the organ, without the intervention of a medium, which often misleads the judgment.

OF SEEING

OF all the senses, that of seeing is the noblest, the most refined, and the most extensive. It enables us not only to perceive thousands of objects at one glance, together with their various figures, colours, and positions; but also to form ideas of the stars and planets at enormous distances. This great field of vision, has, however, been vastly extended by the invention of optical instruments. With the assistance of telescopes we discover new worlds, which, without the assistance of art, would to us have no existence : we see in each grain of sand, a world ; in each drop of water, an ocean.

The structure of the eye is a master-piece of divine omnipotence and wisdom. But without being present at an actual dissection, we cannot give a clear and distinct description of it.

Light is the universal medium of vision. It consists of innumerable rays, which proceed in direct lines from every part of luminous bodies. The motion of light is inconceivably swift : its rays coming from the sun reach this

earth in seven minutes ; and yet the distance of the earth from the sun is so immense, that a cannon-ball, which moves at the rate of 500 feet in a second, could not come from the sun to the earth in less than 25 years. The velocity of light, therefore, is above ten millions of times greater than that of a cannon-ball.

Though the rays of light proceed in direct lines from luminous bodies, they are refracted, or bent out of their course, in passing through different mediums, as the air, glass, and many transparent substances ; but when they fall upon opaque bodies, they are refracted. Rays, proceeding from any object, and passing thro' a convex glass or lens, are, at a certain distance from the glass, collected into a point, which is called the focus. The white light of the sun consists of seven differently coloured rays, or what are called primary colours. Sir Isaac Newton has discovered, that they have different degrees of refrangibility. When the white light passes through a glass prism, it exhibits several distinct colours, which is produced by the several rays of the white light being more or less refracted or turned from their direct course. The primary colours are red, orange, yellow, green, blue, indigo, and

violet. Red is the least, and violet the most, refrangible part of white light. A proper mixture of all the seven primary colours constitutes whiteness, and by various mixtures of the primary colours, all the compound colours either in nature or art are produced. Any surface appears black when it reflects little or no light.

Two questions with regard to vision have ever been difficult to decide.... Why does the soul think and figure to itself every object erect, though the pictures are inverted on the retina? Why do we see every object singly, though a separate image of every object is painted on the retina of each eye?

INFANCY OF THE ANIMALS.

THAT portion of life which commences at birth, and terminates at that period when animals have acquired the power of self-preservation without any assistance from their parents, is termed infancy ; which in some has different limitations with regard to time.

In the human species it continues longer than in any other animal. At first sight we conceive a humiliating and melancholy idea, that infants, the noblest creatures in nature, should immediately after birth, be extremely helpless, and seem to be more so than brutes over whom it is born to reign. Its uncertain life seems every moment to vibrate on the borders of death....it has scarcely force enough to announce by groans, the pain it suffers ; and yet it is not quite helpless. The Creator has given to the mother a high degree of tender feelings, which disposes her to take the utmost care of the infant. Besides, the instant after birth, it is capable of sucking whatever is presented to its mouth. The young of hares, rabbits, mice, &c. can do no more. Some quadrupeds are destitute of the sense of seeing for several days

after birth. But infants bring the faculty of vision with them into the world, which in a few hours becomes to them a great source of pleasure and amusement. The young of most birds have no other powers but those of respiration, opening their mouths to receive food, and of rejecting their excrement. Besides, it ought to be considered, that men in society, by luxury, by artificial modes of living, by vicious habits, debilitate their bodies and transmit to their progeny the seeds of weakness and disease; the effects of which are not felt by the savages, who live more agreeably to the intentions of nature, and whose children, therefore, are more robust and more healthy. Even among civilized nations a similar gradation of weakness and disease is to be observed. The children of men of rank and fortune are in general more puny, debilitated, and diseased, than those of the peasant or artificer: therefore, what proceeds from the faults of man, nature ought not to be censured for. However, children in their progress from birth to maturity, have innumerable sources of pleasure, which compensate the short pain which unavoidably must be endured whether in a more natural or more artificial state of mankind. If the civilized inhabitant of the earth is subject to more

weaknesses and wants, than the savage, he has to expect more real enjoyments and advantages from his state of cultivation. The savage has fewer wants, but his gratifications are more than proportionally diminished. However, the question, whether the raw state of nature or the artificial and cultivated state of society be the most preferable, can be decided in a few words. Ask the savage, whether he would change his situation with ours, and let us ask ourselves whether we would prefer his situation to ours? If the answer is in the negative, the controversy ends with the joyful reflection, that the Creator has rendered all his creatures capable of enjoying the pleasures of life according to their situations, and that every being is in its nature happy.

It is to be hoped, however, that the physical education of children will be more and more confined to the simple dictates of nature. The swaddling bands were originally intended to prevent the head and limbs from being distorted; but it was not considered, that the efforts made by infants to disentangle themselves have a greater tendency to produce the same, if not worse effects. Infants, as well as all young

animals, are extremely prone to motion. It invigorates their members, and facilitates the circulation and secretion of their different fluids. The want of exercise retards their growth and weakens their constitution; therefore, children who are allowed full freedom of motion are always the most healthy and the most vigorous. The savages, and the ruder nations, in the education of their children, follow more the dictates of nature. The negroes, the savages of Canada, of Virginia, of Brasil, and the natives of almost the whole of South-America, instead of using swaddling bands, lay their infants naked into hammocks, or cradles lined with fur. The children of negroes, at the end of the second month, begin to creep on their hands and knees, and soon acquire by habit to run with surprising quickness. Savages are remarkably attentive to the cleanliness of their children. Those of North-America put wood dust, obtained from decayed trees, into the bottom of the cradle, renew it often, and cover the children with skins. In Virginia, as well as in some eastern parts of Europe, particularly in Turkey, they place them naked upon a board covered with cotton, and furnished with proper holes for transmitting the excrement; which prevents the dismal effects that

too often proceed from the negligence of nurses. Many northern nations plunge their new born infants into cold water without receiving any injury. The Laplanders throw them first into the snow and afterwards into a warm bath. During the first year, this is repeated three times every day; and afterwards, the children are bathed in cold water thrice every week; for in northern regions it is a general, and indeed a just opinion, that cold bathing renders men more healthy and robust; and hence they inure their children, from their very birth to this habit. In some parts of America, the mothers bathe in cold water along with their infants, the moment after delivery: but climate and habit make a great difference, so that what may promote the health of one, might be extremely dangerous to another.

The food of infants, for the first two months, should consist of the mother's milk alone. Before the end of the first month, a child may be injured by allowing it any other nourishment. In Holland, in Italy, in Turkey, and in the Levant, children, during the first year, do not receive any other food. The Canadian savages nurse their children four, five, and more years.

In cases of necessity, the milk of quadrupeds may supply that of the mother ; but in such cases the child should suck the animal's teat, for the degree of heat is always uniform and proper. Several robust peasants have been known to have had no other nurses than ewes. After two or three months, children may be gradually accustomed to other food. As long as a child has no teeth, and therefore is incapable of mastication, it should be nourished solely by soft substances ; but as soon as the teeth shoot through the gums, it is obvious that nature intends they should then be allowed food of a more solid kind.

The bodies of infants are delicate, yet they are less affected by cold than at any other period of life ; which effect may be produced by the superior quickness in the pulsation of the heart and arteries, which takes place in small animals. The pulse of an infant is more frequent than that of an adult. The pulse of a horse or an ox is slower than that of a man ; and the motion of the heart in very small animals is so rapid that we cannot count the strokes.

The lives of children, during the first three or four years, are extremely precarious ; but then their existence becomes gradually more certain. From Simpson's tables of mortality it appears, that of a certain number of infants, born at the same time, more than a fourth part die in the first year, more than a third in two years, and at least one half at the end of the third year. This experiment was made upon children born in London ; in other places this mortality of children is not so great, for it has been found that in France one half of the children, born at the same time, are not extinct in less than seven or eight years.

The causes of this great mortality lay partly in the diseases they are subject to, but in general they are to be ascribed to unnatural practices in the management of children, introduced by superstition, by ignorance, by over refinement, by prejudice, and hypothetical systems ; while the simple path of nature is almost totally neglected. Every animal, except the human species, brings forth its young without any foreign aid. But how many infants and mothers are daily maimed, enfeebled, and destroyed ; by the ignorance and barbarity of midwives and

accoucheurs, by their endeavours to out do nature, or stem its benign operations. Nature's medicine for cleansing the bowels of infants, is the milk of the mother. But midwives and nurses imagine that the apothecary's shop contains better means for that purpose, and give them besides unnatural kinds of nourishment. All other animals nurse their own offspring. But human mothers delegate but too often this tender and endearing office to strange women, who, with their milk, instil into the infants their vices and their diseases. In the first period of existence, very little food, but a great deal of rest, is necessary for promoting the health, and securing the ease and tranquility of infants; for, when not teased by officious care, they almost continually sleep during several weeks after birth. Young animals are naturally fond of being in the open air: but our infants, particularly in large towns, are almost perpetually shut up in warm apartments, which relaxes both their bodies and minds. The great strength, agility, and proportions in the limbs of savages, are results of a hardy education, of enjoying the open air often, and of an unrestrained use and exercise of all their organs.

In young animals, as well as in infants, there is a gradual progress both in bodily and mental powers from birth to maturity. They are unfolded sooner or later, according to the nature and exigencies of particular species. In man this progress is very slow. He never acquires his full stature and strength of body till several years after the age of puberty; and his mental faculties cannot be said to be perfectly ripe before his thirtieth year. The proper wisdom of life is unknown to many grey-headed men: but this is a subject more fit for a moral than for a natural philosopher. But the difference in the progression of the mental faculties has its cause in the nature and connection of things, and is often the effect of our own or foreign neglect.

If the history of the wonderful child at Lubeck* be true, of which we have no reason to doubt, this child is a real secret of nature. It remained as long as it lived in the arms of its nurse. In ten weeks after its birth it gave signs of notions and of words. In its fourteenth month it knew the history of the Bible. Before the end of its third year of age, it had

* The life, actions, journies, and death of a very sagacious child of four years old. 2d Edit. Gottingen, 1779.

made great progress in history, geography, anatomy, religion, and the history and genealogy of Denmark. At the beginning of its fourth year, its teacher commenced with it a course of dogmatic, ecclesiastical, and natural history. It was then carried to Copenhagen, and presented to king Frederick IV. The rapid manner with which the mental faculties of this child unfolded themselves, will ever remain an indissoluble question. Whatever it heard, it retained in its memory, as a candle would light another. Its little body was extremely tender and sickly, and the operations of its mental faculties soon overpowered the weakness of its body. After its death, the public prints were filled with accounts of this phenomenon; an engraved likeness appeared in public, and the poets sung its praises.

In early infancy the memory appears to be weak, though the impressions received from new objects must be strong. The cause of this is, that almost every object is new, and, of course, ingrosses the whole attention. By the quick succession and novelty of others, the idea of any particular object is obliterated.... Therefore, memory ripens not so much by a gradual increase in the strength of that faculty,

as by a diminution in the number and novelty of the objects which solicit attention. At the time when children are enabled to express all their wants and desires, the number of new objects daily diminishes, and the old and familiar objects become comparatively small and uninteresting. Hence the ardour of their minds begins to relax; and this is the period when it is necessary, instead of a mere gratification of their senses, to lead children by various artifices to the examination of particular objects, and to open to them the refined sources of information. The great art of moral education consists in exercising the attention. When this point is gained, the minds of children may be moulded into any form. But that restlessness, which nature, for the wisest purposes, has implanted in the constitution of all young animals, should not be too severely checked; for, health and vigour of body are the surest foundations of strength and improvement of mind.

The elephant requires thirty years, and the rhinoceros twenty, before they come to perfect maturity, and are enabled to multiply their species; but long before this period, they are capable of procuring their own food, and are

independent of any aid from their parents.... Other quadrupeds, in a much shorter time, are capable of procuring their own food, viz. the camel, the horse, the larger apes, &c. Most of the feathered tribes arrive at perfection in less than six months. The fishes (if the whale and seal kind, who suckle their young, be excepted) receive no aid from their parents. With regard to sagacity there is a great difference between the divers species of animals, and the fishes must be ranked in the lowest gradation. Their general character is stupidity, joined to a voracious and indiscriminating appetite for food. They devour without distinction every smaller or weaker animal, whether it belongs to a different species or to their own. Insects undergo so many changes, and assume such a variety of forms, that it is difficult to determine the period of their infancy. The moment an insect receives existence, it finds its nourishment on the very spot of its birth, for the mothers uniformly deposit their eggs in situations which afford both protection and nourishment to their young, except the bees and some other flies, who not only construct nests for their young, but actually feed and protect them. In general, nature has uniformly, though by various modes, provided for the nour-

ishment and preservation of all animal beings, as long as they cannot provide for themselves. Though the human species continue in a state of infancy longer than any other animals, the attachment and solicitude of both parents to their progeny constantly augment, and commonly remain during life ; and this reciprocal affection of parents and children is one of the greatest sources of human happiness. If the love of children were not strong, and if it did not increase with time, the attention, anxiety, and fatigue of mothers would be insufferable. But our all-wise and all-beneficent Creator has made it so, that affection braves every difficulty and soothes every pain. If a child be sickly, and requires uncommon care, the mother's tenderness increases in proportion. Pity unites with love, and hardships and fatigue are suffered with cheerfulness and alacrity. Even quadrupeds and birds have a strong and marked affection for their offspring, with this difference only, that whenever the young begin to be in a condition to protect and provide for themselves, the attachment of the parents gradually subsides ; they banish them with blows from their presence, and seem to have no knowledge of the objects which so lately had engrossed all their attention and labour. Here the dignity and

superiority of man appears in a conspicuous light. Instead of forgetting his offspring, after they arrive at maturity, his affection expands and embraces grand children and great grand children with the same tenderness as if they had immediately originated from himself.

GROWTH AND FOOD OF ANIMALS.

ANIMALS, as well as plants, require food in order to expand and strengthen their parts when young, and to preserve health and vigour after they have arrived at maturity. The food of animals is digested in the stomach and intestines, converted into chyle, absorbed by the lateral vessels, and after being mixed with the mass of blood, it promotes growth and repairs the waste of animal bodies. Mysterious as this process of nature is, it has given rise to several ingenious theories.

Buffon ascribes to the parts of animals and plants a creative power ; he considers them as *internal moulds*, according to which the matter of nutrition is formed, and each part receives and applies those particles only which are peculiar and necessary to its own nature, so that the whole parts of the body are gradually and proportionally augmented. This nutritive matter, he says, is organic, and similar to the body itself ; and hence the size of the latter is increased, without any change in its figure or substance. The matter ejected by excretions,

is a separation of the dead from the vivifying and nourishing parts. An active power, similar to that of gravity, penetrates the internal substance of the body, attracts the organic particles, which are thus pushed on through all its parts. To unfold an embryo, or germ, nothing more is requisite than that it contains in miniature a body similar to the species, and be placed in proper circumstances for the acquisition of fresh organic particles to increase its size, and unfold its members.... Hence, nutrition, developement, and reproduction, are all effects of the same cause.... But what do we learn from this theory? Nothing, but what we know already; that animals and vegetables grow by the intervention of the nutritious particles of food: but we are still as ignorant as ever, how this mysterious operation is performed.

Others have supposed, that the brain is a large gland; that the nerves distributed over the whole body are the ducts or canals of this gland; that the brain secretes nutritious matter and transmits it by the nerves to the various parts of the system, in order to expand the different organs, or to repair the waste they

may have suffered from labour and other causes.

This supposition is uncertain, because it presupposes that the nerves are tubular, and contain a fluid; circumstances, which have hitherto eulded the research of the ablest anatomists. Dr. Monro has rendered it highly improbable, that the nerves are the instruments of nutrition. The brain of an ox, who in two years acquires his full size, and whose brain weighs not above a fourth part of that of a man, must, on the above supposition, secrete twenty-four times more nourishment than a portion equal to it of the human brain, and must of course be supposed to transmit daily through the nerves two or three pounds of flesh, bones, &c. whilst the much larger brain of a man does not, in an equal time, add to his body a fifteenth part of that weight. In miscarriages, or monsters, the limbs have been found perfect, though the brain was very small; others, with the usual quantity of brain, had weaker or defective limbs. Organs, of which the nerves are so small that we cannot trace them by dissection, grow as quickly as those in which the nerves are large and strong.

The more rational and profound physiologists suppose, that the nutritious parts of victuals pass through the arteries into the various parts of the animal body, in order to expand and perfect them. The glutinous part of the blood, or the coagulable lymph, resembles the white of an egg. That the white of an egg is the sole nourishment of the chicken before its exclusion, is an established fact; and the conclusion, from analogy, that the lymph of blood is destined for the growth and reparation of animal bodies, is by no means unnatural.

Bonnet endeavours to shew, that the parts of all organized bodies are contained in miniature in germs or buds; that these germs, when placed in proper situations, gradually unfold and increase in magnitude; that the various members of animals and vegetables are expanded, both longitudinally and laterally, by food adapted to their respective natures; and that every germ actually includes the rudiments of the whole animals or vegetables which are to proceed from it during all successive generations. This idea may be excused by the effect of appearances in the vegetable kingdom. The seed of the germ indeed contains in miniature the plant in all its parts: from this plant a bud

or germ is found, which contains the shoot of the tree that is to spring next season. In the same manner the small tree of the second year produces a bud, which includes a tree for the third year: and this process uniformly goes on as long as the tree continues to vegetate. From these and similar facts, it is thought reasonable to conclude, that all those germs were contained in the original seed which would be formed in a hundred years, and those which would successively arrive, till the final destruction of the species. But, though these facts are known, the reasoning deduced from them is incomprehensible. The seed is unquestionably the origin or cause of all future individuals, which may be infinite: but that the germs of all these individuals should be contained in it, exceeds all the powers of human imagination to conceive. Can every seed, and every animal, include in its own body the source of an infinite posterity? Instead of throwing light upon the subject, we shall, by such doctrines, lose ourselves in the labyrinths of infinity, and involve the subject in tenfold darkness. All we know is, that in the animal kingdom, nutrition is performed by means of the blood, which is propelled through every part of the body, by the action of the

heart and arteries ; and that vegetables, in a similar manner, are nourished by the ascension and distribution of the sap. But, how the nutritive particles are applied to, or mixed with, the various parts of organized bodies, expand the organs, or repair the continual waste and loss of substance, we shall, like of many other secrets in nature, remain in ignorance.

The food of animals, and particularly of the human species, consists of animal and vegetable substances, combined with water or other fluids. The Gentoos in Hindostan, and some other southern nations, live almost entirely upon vegetable diet. From the accounts we have of the different regions of the earth, it appears, that the natives of warm climates, where the cultivation of plants is practised, employ a greater proportion of vegetable food than in the northern countries. The inhabitants of Lapland have little dependance on the fruits of the earth : they neither sow nor reap : all their riches consist intirely of the number of rein-deer, whose milk and flesh is their principal nourishment, and of whose skins they make their garments. In autumn they catch great multitudes of fowls, with which they not only supply their present wants, but dry and preserve

them through the winter: they likewise kill hares, and other animals, which abound in the woods and mountains; but the flesh of the bear is their greatest delicacy: they drink water, or animal oils, but never taste bread or salt: their lakes and rivers afford to them inexhaustible stores of fishes, which in summer they dry in the sun, and in winter they are preserved by the frost. The Laplanders live in a pure air, and have sufficient exercise: their constitutions are inured to the coldness of the climate, and they are remarkable for vigour and longevity. The gout, the stone, the rheumatism, and many other diseases, which torture the luxurious in milder climates, are unknown to them: they are satisfied with the few gifts which the Creator has bestowed on them, and live happily among their ice mountains and their storms. If southern nations feed nearly on vegetables alone, the Laplanders furnish one of the opposite extreme, who eat almost entirely carnivorous animals. The same observation is applicable to Norway, Sweden, Germany, and Britain, where animal food is much more used than in France, Spain, Italy, Barbary, and the other southern regions of the globe. Many reasons may be assigned for these differences in the food of

nations. In warm climates we find a greater quantity of luxuriant vegetables, and fruitful trees, which grow spontaneously without the aid of cultivation. The richness of their fruits far exceed those of colder regions. This circumstance stimulates the natives to use a proportionally greater quantity of vegetable food. In cold countries the vegetables are fewer and less nourishing. This obliges the inhabitants to live principally on animal substances. In proportion as men approach or recede from the poles, a greater or less quantity of animal and vegetable substances are used in their diet. Besides, form of government, laws, religious rites, and custom, produce considerable differences in the articles of food among some nations. In countries where men are not fettered by political institutions, or prejudiced by extraneous circumstances, the nature of their food is invariably determined by the climate and the productions of the country: culture, luxury, and imitation, produce, however, many exceptions. If the natives of the islands in the south sea, which have been discovered by Anson, Carteret, Cook, and others, become once acquainted with the European and other civilized nations, they undoubtedly will lay aside that enormous custom of man-eating, and use

themselves to the food which their soil and climate so richly produces. Even in Europe, nations have existed who fed on human bodies and raw victuals, till the culture and use of the potatoe and other nourishing vegetables were introduced.

Whether man was originally intended by nature to live solely upon animal or vegetable food? is a question which has been much agitated both by the ancients and the moderns. Many circumstances concur in establishing the opinion, that man was designed to be nourished neither by the one nor the other solely, but by a mixture of both. Agriculture is an art, the invention of which depends on a number of fortuitous circumstances. It requires centuries before savage nations learn and practice this art. Many nations depend entirely for their subsistence upon hunting wild animals, fishing, and such fruits as their country happens spontaneously to produce. This has uniformly been the manner of living among all the savage nations of which we have any proper knowledge; and seems to be a clear proof, that animal food is by no means repugnant to the nature of man. Besides, the surface of the earth, even in the most luxuriant climates, and in the

best state of cultivation, would not be capable of producing vegetable food in sufficient quantity to support the inhabitants of any region, which has become as populous as Britain, France, or Germany. Even the general practice of mankind, when not restrained by prejudice or superstition, of feeding promiscuously on animal and vegetable substances, is a strong indication that man is, partly at least, a carnivorous animal.

The Gentoos afford no proper argument against this reasoning; for by their religion they are obliged to abstain from the flesh of animals; and they are only allowed to use milk, which is a very nourishing animal food. Notwithstanding this indulgence, the Gentoos are a meagre, sickly, and feeble race. In hot climates, the great proportion of vegetable food which there is made use of, indemnifies the greater quantity of animal food. The greatest proof, however, lays in the structure of the human body itself. Those animals which feed upon vegetables alone, have larger stomachs and intestines than those that live solely on animal food. Man, like the carnivorous tribes, is furnished with cutting and canine teeth, and, like the granivorous, with a

double row of grinders. The dimensions of his stomach and intestines likewise are smaller. From all these arguments, it is evident, that it is no deviation from the original nature and destination of mankind, if they, whatever country they may inhabit, kill animals and convert them to their use. No general rule can be given, with regard to the different proportions of animal and vegetable food. Animal food certainly gives more strength, and may be used more liberally by the active and laborious, than by those who lead a studious and sedentary life. A great proportion of vegetable food, and particularly of bread, is considered as better adapted for men who are fond of science and literature.

By experience, and the aid of our senses, we acquire a facility of distinguishing salutary from noxious food, and to select those which best agree with our constitutions. Even other animals in the selection of their food are guided by instinct, and particularly by the sense of smelling, and some by the acuteness of their sight. Rapacious animals, as wolves and ravens, discover carrion at a distance, which to us appears to be altogether incredible.... Eagles, hawks, gulls, &c. perceive from great

heights in the air, mice, small birds, and minute fishes in the water. One great cause of the diffusion of animals over every part of the globe, is to be derived from the diversity of food, for which different tribes have particular appetites implanted in them by nature, and which food is to be found in certain regions only. Some fishes are only to be found in certain latitudes. Some animals inhabit the frigid, others the torrid, zone; some frequent deserts, mountains, woods, lakes, and meadows. In their choice and situation, they are uniformly determined to occupy such places as furnish them with food accommodated to their nature. Monkeys, the elephant, and rhinoceros, fix on the torrid zone, because they feed on vegetables, which flourish there during the whole year. The rein-deer choose the cold regions of the north, because those countries produce the greatest quantity of moss, which is their beloved food, and which they dig up from under the snow. The pelican makes choice of dry and desert places to lay her eggs; when her young are hatched, she is obliged to bring water to them from great distances, for which purpose the Creator has provided her with a large sack, which extends from the lip of the under mandible of her bill to the throat, and

holds as much water as will supply her brood for several days. This water she pours into the nest to cool her young, to allay their thirst, and to teach them to swim. Lions, tigers, and other rapacious animals, resort to these nests, drink their water, and are said not to injure the young. The goat ascends the rocky precipice, to crop the leaves of shrubs and other favorite plants. The sloth and the squirrel feed upon the leaves and the fruit of trees, and are therefore furnished with feet which enable them to climb. Water-fowls live upon fishes, insects, and the eggs of fishes.... Their bill, neck, wings, legs, and whole structure, are nicely fitted for enabling them to catch the food adapted to their natures. Their feeding upon the eggs of fishes accounts for that variety of fishes which are often found in lakes and pools on the tops of hills and mountains remote from the sea and from rivers. The bat and the goat-sucker fly about during the night, when the whole air is filled with moths and other nocturnal insects. The bear acquires a prodigious quantity of fat during the summer, and lives upon it in winter: for some months he receives his sole nourishment from the absorption of the fat which had been

previously accumulated in the cellular membrane. Bears, foxes, gluttons, and other rapacious animals in Siberia and Kamschatka, render those regions the abodes of misery and desolation, but they supply the natives with both food and clothing. To elude the attacks of ferocity, and to acquire possession of the skins of such creatures, which are demanded by foreigners, the industry and dexterity of savage nations are excited: the savage thereby learns commerce and the arts of life; and in process of time, bears and wild beasts become the instruments of polishing a barbarous people; and thus apparent misfortune often produces substantial good. Young animals must be well nourished till they attain their full growth. There is hardly a plant that is not rejected as food by some animals, and ardently desired by others: some plants afford proper nourishment to some animals, and are not only hurtful but even poisonous to others. Such insects as feed upon dead carcasses, and whose fecundity is great, never attack live animals. The flesh-fly deposits her eggs in the bodies of dead animals, but never in the flesh of sound and living animals. If nature had determined her to observe the opposite conduct, men, quadrupeds, and birds, would have been dread-

fully afflicted by the ravages of this single insect.

We will dismiss this chapter with an account of the latest discoveries of the process of digestion.

The stomach of any animal has a power of dissolving, and converting into chyle, every nutritive substance thrown into it. Some natural philosophers have maintained, that the stomachs of all animals comminuted, or broke down into small portions, every species of food, and prepared it for being converted into chyle. The chymical philosophers, on the contrary, supported the opinion, that the food was dissolved by a fermentation induced by the saliva and gastric juices. Spalanzani, professor of natural history, at Pavia, in his two volumes on this subject, relates not only the discoveries of his predecessors, but has enriched his work with numerous experiments and observations made by himself. At first he made experiments on animals with strong muscular stomachs, as common fowls, turkeys, ducks, geese, pigeons, &c. In imitation of Reaumur, he made use of small glass and metal balls and tubes, perforated with many holes, which, filled

with barley, he forced down the throats into the stomachs of those animals, where they remained for twenty-four, and in some cases for forty-eight, hours; when he opened the animals, took the balls out, but could not discover that the gastric juice had made the smallest impression upon them: he then made the same trials with masticated or bruised grain, and invariably found, that the grain was more or less dissolved in proportion to the time the balls were allowed to remain in the stomach. Tin tubes full of grain, when thrown into the stomachs of turkeys and allowed to continue there for a considerable time, were found to be broken, crushed, or distorted. . Spalanzani fixed twelve strong tin needles in a ball of lead, the points projecting about a quarter of an inch from the surface, and forced it down the throat of a turkey, who retained it for a day and a half without shewing the least symptom of uneasiness: the points of the needles were broken off close to the surface of the ball, except two or three, of which the stumps projected a little higher. He made a still more cruel experiment, by fixing twelve small lancets, very sharp both at points and edges, such as he used for the dissection of small animals, in a similar ball of lead, and giving it to a turkey:

after the expiration of eight hours, the animal was opened, but nothing appeared except the naked ball, the twelve lancets having been broken to pieces: the stomach was found to be sound and entire; which are sufficient proofs of the wonderful comminuting force of the stomachs of those animals. Spalanzani, by his own experiments, became convinced, that the small stones which are so frequently found in those stomachs, are not all necessary to the trituration of the firmest food, though when put in motion by the gastric muscles, they may produce some effect on the contents of the stomach, and supply in birds the want of teeth.

He made other experiments upon ravens, crows, &c. the power and action of whose stomachs are superior to those of the membranous kind, but greatly inferior to those of the muscular. The tin tubes or balls, which in pigeons and turkeys soon were flattened and disfigured, remained unaltered in the stomachs of crows. Yet, though they are unable to distort tin tubes, this effect they produced upon tubes of lead. On this kind of birds experiments may be repeated without destroying any of them, because they have the power of disgorging substances which they are incapable of digesting,

in the same manner as falcons and other birds of prey throw up the feathers and hair of the animals they have devoured. When the tubes were filled with entire grains, as wheat or beans, the gastric juice exerted no solvent power. But when the grains were bruised, and the experiment repeated, it was found that they were dissolved and almost digested. When he fed the crows with these seeds, he observed, that before they swallowed them, they set them under their feet, and reduced them to pieces by repeated strokes of their beaks. But, when the birds from excessive hunger, swallowed the seeds entire, they passed from them entire. Similar experiments he made with pease, bread and apples.

He finished his experiments on digestion with those animals which have thin membranous stomachs, as frogs, reptiles, fishes, sheep, cows, horses, eagles, dogs, men, &c. &c. In these the coats of the stomach have little or no action upon their contents, the gastric juice being fully sufficient to break down the food and reduce it to pulp.

Dr. Stevens, at Edinburgh, made several experiments in order to determine the power of

digestion in the human body. He for that purpose made use of a German who, from his seventh year of age, gained a miserable livelihood by swallowing stones for the amusement of the people, some of which were as large as a pigeon's egg. The doctor made him repeatedly swallow a hollow silver sphere, divided into two cavities by a partition, and perforated with a great number of holes, which as often passed from him. At one of these experiments it was found, that live leeches and earth worms, which had been put in different spheres, were found when discharged, to be not only deprived of life, but completely dissolved; which proves that no animal, except those worms which are hatched in the human intestines, can resist the dissolving power of the gastric juice. Dogs are unable to digest vegetables, and sheep and oxen cannot digest animal substances. But the human stomach is capable of digesting both, which is an irresistible proof that nature originally intended man to feed promiscuously upon both.

The chymical preparation and the internal situation of the gastric juices, belongs to those secrets of nature which hitherto have baffled the researches of the most eminent natural philosophers.

OF THE SEXES OF ANIMALS.

ALL the larger and more perfect animals are distinguished by the sexes of male and female. The bodies of males are in general stronger, larger, and more active, especially in the man, who does not acquire his full growth, and best form till he arrives at the age of thirty years. In women, the parts are rounder, and their muscular fibres more feeble and lax than those of men, and their growth and form are perfect at the age of twenty. Man is bold, generous, and enterprising. Women are timid, jealous, and disposed to actions which require less agility and strength. Hence they not only claim, but by their amiable weaknesses actually receive, our protection. Men are endowed with majesty of figure and force of mind ; but beauty and the graces are the proper characteristics of women. The laxity and softness of their texture may be the cause of their timidity ; for when the bodies of men are relaxed by heat, or by any other cause, their minds become not only timid, but weak, undetermined, and inactive. The social intercourse of women softens the dispositions and soothes the cares and labours of the men : their little

female humours, caprices, and follies, give rise to many exertions of virtue: they excite in us compassion, humanity, and tenderness of affection: the delicacy of their bodies, and the weakness of their minds, require our support and protection; but for this they reward us by their gentle and insinuating manners, which have a direct tendency to soften the natural roughness of men. In most countries, women take the entire management and education of children upon themselves, till their characters and dispositions are almost fixed for life: this is highly important for the state; it is an office which would require more education and sense than they commonly receive either from nature or art: but the persevering patience and attention of women, especially when children are sick or weakly, is so astonishing, that no man could perform the painful task: they also suffer bodily pain with more resolution than man; and if man is an oak tree, which a storm may break, woman is a rose bush, which with elasticity bends to the wind and then raises itself more refreshed and blooming: they reason rapidly, but their reasoning is seldom solid, though often acute.

Modesty is one of the most distinguished and attractive characteristics of the female sex. This is the great defence with which nature has armed them against the artifices and deceit of the males. This virtue has both an attractive and repulsive power. It heightens the desire of the male, and deters him from rudeness or improper behaviour. Were women deprived of this amiable quality all their charms would vanish, and the ardour of love would be extinguished. Yet women ought to guard this virtue against degenerating into prudery. It is the interest of females to cultivate modesty and to guard against the smallest incroachments. A single glance of the eye from a modest woman can punish a man of sensibility, and prevent improper conduct. There is no part of the female character which men revere so much as modesty. It is the brightest and most valuable jewel with which a woman can be adorned. A woman without modesty, however beautiful, instead of gaining the affections of men, becomes an object of contempt, and even of disgust. It equally is the duty of men not to injure, but to cherish a quality, from which they derive so much pleasure.

Even in the brute creation we discover evident traces of a species of modesty ; for, even so low as the insect tribes, most females repel the first attacks of the males. If this does not merit the name of modesty, it has all the effects of it. It heightens the affection of the males, and makes them employ every alluring art to procure the regard of the female. It is a remarkable fact, that most carnivorous quadrupeds are more averse to attacking women than men. The bears of Kamschatka follow the women when gathering wild fruits in the woods, and though most rapacious animals, do them no further harm than robing them of part of their fruit. The aspect of men being more bold, creates perhaps an idea of danger, and excites the ferocity and courage of the animal. In general there seems to be an instinctive respect for the human kind implanted in animals. If this be the case, the above fact amounts to a high compliment to the women ; for they receive more favor from the brute creation than the men. In some of the lower tribes there is no difference of sexes, and in some animals both sexes are combined in each individual.

Natural philosophers still disagree on the sexual theory of plants. That there are male and female plants, and a certain analogy, as in animals, is beyond a doubt : but, it still is uncertain whether sexual commerce is necessary for the fecundation of vegetables. Plants are multiplied by inoculation, the same as a poly-pus, that is cut in pieces.

OF PUBERTY.

PUBERTY commences at that period, when animals are endowed by nature with the power of multiplying the species. This period is as various as the different tribes of animals ; in some it arrives sooner, in others later ; but in every animal, it is accompanied with some remarkable change. Immediately after that period, the growth of the body makes a sudden spring, and acquires redoubled strength and activity. Some animals, however, continue to grow for some time after the age of puberty. Most of the feathered tribes and fishes seem to acquire their full dimensions before that period.

Before puberty, the voice of man, like that of a woman, is shrill and feeble ; after that time it becomes rough and strong. This effect is produced by some change in the organs of speech, which is remarkable even in other animals, the horse, the colt, &c. In eunuchs, no such alteration of voice is to be observed ; for their voice remains shrill, and can never produce a low or deep note. With other external

and internal changes, which it is unnecessary to relate, at this period the beard begins to appear ; but eunuchs are totally destitute of beards. Such effects indicate a connection of causes which merit the attention of philosophers. Also in the female sex constitutional changes take place. The alteration in the tone of their voice, is hardly perceptible ; neither are their faces deformed by a beard, which, according to our ideas, would have a disgusting effect, but their mammæ swell, and a periodical evacuation takes place, which produces wonderful revolutions in their constitution, and becomes the cause of their then unfolding and blooming beauty.

In both sexes, not only corporeal but also mental changes take place ; the force of genius is felt, other objects solicit attention, and desires awake which they never before had felt, Instead of puerile amusements, ambition and unaffected friendship, a generous and manly demeanor both in words and actions, are in general the characteristics of this period of human life ; we feel the full measure of mental and corporeal powers ; all our sensations are stronger ; and in most men, those years are more fertile in honest, noble, and undisguised

sentiments and actions, than at any other period of their life; for, when a young man enters into the business of life, his candour soon meets with a shock. He has to encounter with selfishness, chicane, and too often with direct villainy, which turns his thoughts into a different current, and contracts the noble openness of his heart. And what is often the case, the cares of old age damp the vigour of his mind. This remark, however, though but too generally true, is not applicable to all.

In every race of mankind, the females arrive sooner at puberty than the males. But the age of puberty differs in different countries, according to the temperature of the climate, and the quality of the food. Children who are fed with rich and nourishing victuals, arrive sooner at this state, than those of poor parents, whose food is not only coarse, but too sparingly given. In the southern regions of Europe, and in large cities, the females arrive at puberty about the age of twelve, and the males about fourteen; but, in northern climates, and in the country, girls hardly come to maturity till they are fourteen, and boys not before sixteen. In the warmest regions of Africa, Asia, and America, the age of puberty in females commences at ten, and sometimes at nine.

It does not coincide with nature, that by the effeminacy of our manners and the delicate way of our living, we should, as plants in hot-houses, arrive at puberty sooner, or be pent up by political systems. After puberty, marriage is the natural state of man. A man ought to have but one wife, and a woman but one husband. This is the law of nature ; for the number of females is nearly equal to that of the males. Such laws as have been enacted in opposition to this natural principle, have originated solely from tyranny and ignorance. Reason, humanity, and justice, revolt against those odious seraglios, in which the liberty and the affections of many women are sacrificed to the brutal passion of a single man. Does such a pre-eminence render such a tyrant the more happy? No! surrounded with eunuchs, and with women who are useless to themselves and to other men, he must be tormented with the constant appearance of that accumulated load of misery, of which he himself is the cause. The state cannot be too careful in preventing another still greater evil, the *onan*y, which creeps in the dark, and whereby thousands of human beings become stifled and killed in the bud, or are born miserable and weakly. Therefore the endeavours of Tisot, Salzman, Campe, in their writings on that subject are for

the young and growing generations as useful as they are praise-worthy in themselves.

Those changes which follow the period of puberty, also take place in all other animals. They become bold, restless, and ungovernable. Their bodies are then in strength and symetry perfectly accommodated to the new sensations, which nature, for wise purposes, excites in them. In the deer kind, the horns appear not till that period. The crest and the plumage of the male gallinaceous birds acquire then additional beauty, and the animal becomes stronger and more courageous. The pigeon, whenever the age of puberty arrives, assumes a bold and important air, struts about with majestic pride, and addresses, with all the gaiety of a lover, some favorite female. After the female gives her assent, their after conduct exhibits such a mutual affection and fidelity as afford a pattern to the human species.

With regard to fishes, we are in uncertainty ; for, the element they inhabit, the rapidity of their motions, and their wandering mode of living, leave no time for making observations. The economy and manners of insects are

more open to inspection. Those of the winged tribes undergo many changes before they arrive at the age of puberty. First they come from the eggs in the form of caterpillars. In this state they are voracious, and grow with rapidity to their full size ; but they are destitute of the power and the organs for the multiplication of the species. They are next transformed into chrysalids, in which state they are covered with a kind of shell, from which they have again to escape, as from a second egg. They burst this shell and appear in the form of flies, furnished with wings, legs, and other organs, of which they were before destitute, and are then endowed with the faculty of transmitting a numerous progeny to posterity.

TRANSFORMATION OF ANIMALS.

THE transformation of caterpillars has long excited the attention, as well as the admiration of mankind. But in fact, every animal, and even the human species, undergo material changes. In how many different forms does mankind not appear from their embryo state to final dissolution! Even from the time of conception, how many changes do not take place till the period of birth! then from the first to the seventh year of our existence. Again, at the period of puberty a great alteration takes place, and at last from the fiftieth year to the age of sixty or seventy, when the powers of the body decline, and old age becomes the harbinger of dissolution! The mind of man undergoes changes as well as his body.... The taste, the appetites, and the dispositions, are in perpetual fluctuation. How different is the taste of a child from that of a man!.... Children, without any reflection or care, frolic away their time with gewgaws. With the age of puberty, they begin to perceive a sense of propriety. They despise their former occupations, and different species of objects occupy their attention. They begin to reflect, and

both sexes acquire an amiable modesty and shyness, which at last, by the intercourse of society, as well as by the impulses of nature, vanish. Now the young man's mind begins to assume a bold, enterprising, and active tone. He thinks of engaging in the business of life, looks forward to futurity and the establishment of a family; he forms manly friendships, and goes on for some time to enjoy every kind of happiness which nature has destined for him, and to which, according to his faculties and situation, he is susceptible. But at sixty or seventy, the mental powers, in general, like those of the body, begin to decline, till feeble old age arrives, and death closes the mutable scene of human existence, and opens the commencement of a future life.

Similar changes take place in all animals: every one can convince himself of it, if he will take the trouble of examining from beginning to end the history of a dog, horse, deer, &c. It is the same with birds, amphibious animals, and reptiles. Many animals come into the world blind. Crustaceous tribes, serpents, and other reptiles, cast their shells and skins every year; and the old skins, like the first set of teeth in children, are forced off

by the growth of the new. The feathered tribes change their feathers, and quadrupeds their hair.

The most wonderful transformations happen in insects. All winged insects, and many of those which are destitute of wings, must pass through several changes before they arrive at the perfection of their natures. The appearance of a caterpillar, of a chrysalis, and of a fly, is so different, that persons unacquainted with their transformations, consider them as three distinct species. Who could believe that a butter-fly, with four beautiful wings, proceeded from a disgusting, hairy caterpillar, provided with jaws and teeth, and fourteen feet? Who could imagine that a long, white, smooth, soft worm, hid under the earth, should be transformed into a black, crustaceous, horny beetle, provided with wings? The life of the winged insects may be divided into three periods: at first it is a worm, or caterpillar, with a long body, perforated with holes on both sides, and capable of crawling about in quest of food. Caterpillars, and especially the silk-worms, cast their skins many times, and a day or two before this happens, they take no food: in the second period, the insect

appears in the chrysalis state : when about to pass into this state, which is a state of imbecility, caterpillars select the most proper places for concealing themselves from their enemies : some, as the silk-worm, and many others, spin silken webs, or cords, round their bodies ; others hide themselves in the earth ; others creep into the crevices of old walls ; others suspend themselves to the twigs of trees and plants. In this state they seem not to possess any powers of life ; but still the power of respiration and a spark of life continues.

Crysalids differ in their appearance and colour : some shine like pure gold ; others are brown ; some are green ; and indeed they are to be found of almost every colour. Sunk into a kind of deep sleep, they remain fixed in those situations which they have chosen for their temporary abode, till by their transformation they are called to a new life. In the third period, the insect has acquired that perfect organization which corresponds to the rank it is to hold in the scale of animation : the bonds are now burst asunder, the members of the animal expand, and it appears in a new and more beautified form ; the insect quits its grave, flies into the air, and leaves its former shell in

or upon the earth. How different is now its appearance, its life, its destination! even the internal parts of the insects undergo as many changes as the external: the texture, the proportions, and the number of the viscera, are greatly altered; some receive a new form, and others are entirely annihilated; some organs, which seemed formerly to have no existence, are unfolded, and become visible; especially the organs of generation, which in the caterpillar, and chrysalis state, were absent, now render them capable of multiplying their species.

We shall now give some examples which deviate from the common mode. The existence of some is divided into two periods only: they walk in the first, and fly in the second. It seems to be a universal law of nature, that all organized bodies from their birth till they arrive at maturity, grow or augment in size: if a hen were to bring forth an egg as large as her own body; and if this egg, when hatched, were to produce a bird of equal dimensions with either of the parents, it would be considered a miracle. Yet the spider-fly lays an egg from which a new fly is hatched that is as large and as perfect as its mother. The gall-insect makes incisions in the leaves or branches of a

tree, and in each incision she lays an egg: this egg is at first extremely minute; but it soon acquires a considerable bulk, and the gall has arrived at its full size before the worm is hatched. That such small animals should be capable of gnawing an apperture through the thick hard rind of a gall-apple is truly astonishing. One egg, in general contains but one animal, but some animals have been discovered whose eggs contain several embryos.

The moth kind, and the silk-worm, cover their bodies with a cord or clue of silk, of which men prepare and manufacture their most brilliant garments. The figure of the silk-worms is generally oval; and, when spinning, they twist their bodies into the form of an S. The cord is produced by numberless circumvolutions of the same thread, which the insect spins by an instrument situated near its mouth. The silky matter, appears under the form of a gum almost liquid, which is contained in two large reservoirs, contorted like the intestines of large animals, and which terminate at the spinning instrument by two parallel and slender conduits. When the animal has acquired its full growth, its reservoirs of silk are completely filled, which stimulates

the animal to evacuate this glutinous matter, which by the movements and attitudes of the creature while discharging the silk, produce those oval bundles that afterwards clothe and ornament vast numbers of the human species. Man, however proud of his brilliant garments, is for these advantages obliged to brutes and insects. Some insects work in wood : their cods are composed entirely of small irregular fragments of dried wood : but the most solitary of all insects, are those who live in the internal parts of fruits, where they find both a nourishment and safe retreat. The question, how these worms receive their existence in the internal parts of fruit ? is as difficult to solve as that, how frogs exist in the internal parts of stones and rocks ?

It seems that the transformation is not an alteration of the original form, but only the throwing off external and temporary coverings, in which they live and receive nourishment till they acquire that degree of perfection to which they ultimately are destined by nature. Even the eggs of the butter-fly have been discovered in the caterpillar long before its transformation.

That the excrements of a butter-fly should be capable of exciting consternation in the minds of men, and anxiety in whole nations, seems to be almost incredible : but this event has frequently happened in different places and nations. Historians have enumerated, among many other prodigies, showers of blood. Superstition soon discovered in these signs, terrifying omens of fields of battle, misfortunes, and the overthrow of cities and empires. In the year 1608, one of these pretended showers of blood fell in the suburbs of Aix, which without doubt would have been transmitted to us as a great prodigy, had M. de Peiresc the natural philosopher, whose life is written by Gassendi, not discovered the cause of the pretended shower of blood, in the blood-red excrements of the prodigious number of butter-flies, which at that time were flying in the air. That the rain was coloured by the excrements of the insects, is evident from this circumstance, that the rain-water was red in the suburbs and the environs only, where these insects were seen in crowds, and remained in its natural colour in the city ; and that those red drops never fell upon the tops of houses, or upon walls more elevated than the height to which butter-flies generally rise. The pre-

tended drops of blood, therefore, were nothing but drops of a red liquor, deposited by butterflies; which fact is further corroborated by this circumstance, that all these bloody rains, as related by superstitious historians, have happened in the warm seasons of the year, when butterflies are most numerous. Thus the study of natural philosophy dispels ignorance and superstition.

Not only animals, but all organized bodies, pass through successive changes, and of course plants also are subject to mutation. What an amazing difference between an acorn and a stately oak! The seeds of plants may be compared to the chrysalids of butterflies: both contain in miniature all the parts, and undergo as many changes as are necessary for their future perfection. With the exception of a few winter greens, trees and plants in northern climates are, during winter, entirely striped of their leaves, their fragrance, and their flowers, and exhibit to us the images of death and skeletons. But, in the spring, how different are the emotions we feel! Trees and plants, with their splendor of colours and sweetness of fragrance, become then the images of resur-

rection! But even the blossoms, leaves, and fruits, are continually changing.

From all these facts it appears, that both in the animal and vegetable kingdoms, forms are perpetually changing. The mineral kingdom is not less subject to metamorphoses. But, though forms continually change, the quantity of matter is invariable: the same substances pass successively into the three kingdoms of nature, and constitute in their turn, a mineral, a plant, an insect, a reptile, a fish, a bird, a quadruped, a man. In these transformations, organized bodies are the principal agents: they change every substance that either enters into them, or is exposed to the action of their powers: some they assimilate into their own substance; others they evacuate in different forms; and these evacuations make ingredients in the composition of other bodies, as those of insects, whose multiplication is prodigious, and affords a very great quantity of organized matter for the nourishment and support of almost every animated being. Thus, from the [apparently vilest species of matter, the richest productions derive their origin. The most beautiful flowers, the most exquisite

fruits, and the most useful grain, proceed from the bosom of corruption and putrefaction. The powers of nature would soon be exhausted, if what she perpetually gives were not perpetually restored to her. It is a law of nature that all organized bodies should be decomposed, and gradually transformed into earth. While undergoing dissolution, their more volatile particles pass into the air, and are diffused through the atmosphere. In this manner, portions of animals are buried in the air, as well as in the earth or in water. These floating particles soon enter into the composition of new organized beings, who are themselves destined to undergo the same revolutions. All organized matter, therefore, is in constant circulation, which commenced with the world, and will end with it.

It is difficult to determine the intentions of nature in changing forms. However, from the examples above enumerated, we can form some conclusion. In the animal world every successive change is a new approach to perfection. When men, animals, and insects, have passed the period of puberty, and cannot attain a higher degree of perfection, they gradually

decay, till their final dissolution. All the changes in the vegetable kingdom tend to the same point. They shoot, grow, blossom, bear fruit, and die. The intention of their existence is attained, as soon as they cannot grow to higher perfection.

Another intention of nature in changing forms, and in the dissolution of her productions, seems to be the distribution of life to an immensity of successive individuals: were the existence of individuals prolonged only for ten times the periods now established, myriads of animated beings, who enjoy their present limited portion of happiness, would remain in the lap of nought.

Finally, it seems, that the most essential part of the present human happiness, consists in the perpetual change of forms of the surrounding objects. And the observation will not be deemed irrelevant to the subject, whether it is not highly probable that the abovementioned changes and transformations are symbols of the future transformation of man after death, and of his resurrection.

OF THE DURATION OF THE LIFE OF ANIMALS.

IT is a melancholy observation, that according to the general law of nature, all organized bodies should be dissolved. But the periods of dissolution are as various as the species, and the intentions of the Creator in producing them.

The brevity of life in the human kind, has often been regarded as an object of regret.... One half of mankind die before they arrive at eight years of age. From that period to eighty, millions die annually, besides the destruction of war, and other accidents. We know of many instances of men, whose lives were prolonged beyond the usual period of human existence; but we doubt whether they are to be envied, or considered as favorites of nature. If maturity of judgment, and a knowledge of the world constitute real life, no man can be said to exist till he passes thirty years of age: give him thirty or thirty-five more, and both his mind and body will visibly decline. Those people, therefore, who arrive at an extraordinary age, exist, but they do not live; for, all intellectual enjoyments, which constitute the

chief happiness of man, are gone. Some of our forefathers, in the early ages of the world, have lived several centuries, but they must have been very different both in the structure of their bodies and in their manners. From infancy to manhood, there is a gradual growth of the organs. When we advance in years, the bones harden, the muscles turn stiff, the cartilages are converted into bones, the membranes into cartilages, and the whole fabric, instead of being soft and flexible, becomes rigid, inactive, and feeble. We have examples that men, who lived intemperately, have arrived at extreme old age; yet, the only means of prolonging life is temperance, a cheerful disposition, moderate exercise of the body, and proper exertions of the mind.

At the time of Vespasian, there were found in different parts of Italy, people who lived to the age of 100 to 150 years.* Such examples we find also in modern times, especially in countries where luxury has not yet found its way. The most extraordinary instance of longevity in modern times, is Henry Jenkins, a native of Yorkshire in Great-Britain, who lived to the age of 169 years, and died in 1670. Even at the present time, examples of people

* Plin Hist. Nat. lib. vii.

living above a hundred years, are not unusual. They in general are people born of as healthy parents as themselves, of healthy structure, and of a hard and temperate mode of living.

The causes of death are the stagnation of the fluids, and the hardening of the firmer parts of the body. But in the female sex the bones, the cartilages, the muscles, as well as every other part, are softer and less solid than those of men; neither are they so much subjected to bodily exertions: their constituent parts, therefore, require more time in hardening to that degree which occasions death. Women, of course, live longer; and the bills of mortality confirm it; for after women have passed a certain time, they live much longer than men who have reached the same period. The duration of life may in some measure be estimated by the time occupied in their growth. An animal or plant which acquires maturity in a short time, dies much sooner. When children grow with uncommon rapidity, they generally die young. Fishes live long, and some during several centuries; for their bones and cartilages seldom acquire the density of other animals. Large animals, therefore, live longer than small ones, because the former require

more time to complete their growth. Thus, the causes of our dissolution are inevitable; and it is equally impossible to alter them as to change the laws of nature. When the constitution is sound, life may perhaps by temperance be prolonged for a few years; but the varieties of the modes of living, and of the climate, make no material difference in the duration of life, which is nearly the same in the European, the American, the African, the Asiatic, the civilized man, and the savage, the rich and the poor, the citizen and the peasant. Neither does the difference of food, or other comforts of life, make any change in the duration of life. People, who are fed on raw flesh, or dried fish and roots, live as long as those who live upon the most exquisite dainties. If luxury and intemperance be expected, nothing can alter those laws of mechanism, which determine the number of our years.... The difference, which may be remarked in the term of life, is owing to the quality of the air. In general there are more old people in the high than in the low countries. The mountains of Switzerland, Scotland, and Wales, have furnished more examples of longevity, than the plains of Holland, Flanders, and Germany. But it still is, as it was in the time of

Moses; the life of man lasts seventy, and at most eighty, years. Besides accidental diseases, which are more frequent and more dangerous in the latter periods of life, old people are subjected to natural infirmities, that originate from a decay of the different parts of the body: the muscles lose their tone, the head shakes, the hands tremble, the limbs totter, the sensibility of the nerves is blunted, the cavities of the vessels contract, the secretory organs are obstructed, the blood, the lymph, and the other fluids, extravasate and become corrupted: however, the natural decay of the solids appears to be the original cause of all these maladies. When the fluids stagnate, they soon corrupt and corrode the weaker parts of the solids: the causes of our dissolution multiply, our internal enemies grow more powerful, and at last give the deadly stroke which makes the machine stand still. Salomo has given us a beautiful and true description of the gradual decay of man, which causes our death.

In the feathered tribes the duration of life is by no means proportioned to the times of their growth: most of them acquire their full dimensions, and the power of multiplying their

species, in a few months. Swans have been said to live some centuries. Mr. Willoughby, in his Ornithology, gives an account of a goose which was known to be eighty years of age. The Count Buffon informs us, that in several places of France, ravens have been known to live twenty years. Pigeons have been known to live twenty years, and linnets, gold-finches, &c. often live in cages from fifteen to twenty years. Eagles are remarkable for their longevity, and for their power of sustaining a long abstinence from food.

Even some fishes live to great ages. Buffon informs us, that he had seen carps of one hundred and fifty years old. Two methods have been devised for ascertaining the age of fishes, namely, by the circles of the scales, and by a transverse section of the back-bone: when a scale of a fish is examined by the microscope, it is found to consist of a number of circles within one another, resembling those rings that appear on the transverse sections of a tree, by which their ages are computed. Every year an additional ring appears on the tree; and in the same manner the age of fishes is ascertained by the number of circles on their scales, reckoning a year for each ring: the age

of fishes that want scales may be known by separating the joints of the back-bone, and observing the number of rings which the surface exhibits. These methods may indeed be liable to deception, but they are the only natural ones which hitherto have been known. The cause of the longevity of fishes lays partly in the uniformity of the element in which they live, and which is less subject to accidental changes than the air of our atmosphere; partly in their bones, which are more of a cartilaginous nature than those of land-animals, and admit of indefinite extension, and of course continue to grow much longer.

The life of most insects is very short. The ephemeron-flies seldom live above one day or one hour after their transformation; but to continue the species, nature has taken care that myriads of males and females should be transformed nearly at the same instant.

In the vegetable kingdom, the periods of existence differ as much as among animals. The aged oak tree and the rose bush, the cedar and the moss, are evidences of it.

From all these facts it appears, that animals and vegetables have their stated periods of existence, and that their dissolution is uniformly accomplished by a gradual hardening and desiccation of their constituent parts, the operation of which no medicine can retard. The wisdom and duty of man, therefore, consists in resignation, and in sailing down the irresistible current of time with all possible composure. Life, whether short or long, whether fortunate or unfortunate, when the period of death arrives, is of little consequence. Knowledge, virtue, and benevolence, are our only rational enjoyments, and our daily endeavours ought to be to meet death in wisdom and virtue.

The true length of life, as well as our conception of duration, depends on the quickness or slowness of the ideas which pass in our minds, or of the impressions made upon our senses. The succession of our ideas constitutes our time. Should the mind be totally occupied with a single idea for a day or a week, these portions of time would appear as instants: hence, a true philosopher lives as long in one day as an idiot or a savage does in a week or a month spent in mental inactivity

and thoughtlessness. If therefore life, be it long or short, consists in a more rapid succession of ideas and a warmer feeling for agreeable objects, we perceive a wonderful view of the great benevolence of our Creator, who has amply peopled the earth, the air, and the waters ; and has given to each in its nature not only life and feeling, but has also proportioned to them the measure of sensation, and has diffused through innumerable channels life and happiness throughout the whole creation.

SECTION II.

OF THE MENTAL POWERS AND THE INSTINCTS
OF ANIMALS.

OF THE INSTINCTS OF ANIMALS.

THE instincts of animals border so near on the effects of the reason of man, that some natural philosophers have gone so far as to set aside all the difference, and to call the reason of man, instinct; and the instinct of brutes, reason. It is indeed no derogation of the dignity of human nature, if we allow that it bears, in many respects, analogy to that of other animals: but by examining this circumstance closely, we become convinced of the many advantages by which the Creator has exalted man over the brute.

In natural philosophy, the best method of investigating subjects is, first to collect facts and to make experiments, to compare them, and then to draw from them general conclusions. There are pure instincts, and there are instincts which accommodate themselves to

peculiar circumstances and situations, and there are instincts which are improveable by experience and observation. Of all these we shall exhibit some examples.

Pure instincts are those which in the human species, as well as in other animals, instantaneously, and without instruction or experience, produce certain actions as soon as particular objects are presented to them, or when they are influenced by peculiar feelings.

The instinct of sucking appears in children immediately after birth: they suck indiscriminately every thing brought into contact with their mouths. The voiding of urine and excrement, sneezing, retraction of the muscles when any painful stimulus is applied, the moving of the eye-lids, and other parts of the body, are effects of instincts, which, like the appetite for air, are innate, and essential to the existence of young animals. The love of light is exhibited by infants a few days after birth: they constantly turn their eyes towards the light. By approaching the hand to the eye of a child, and by any sudden motion or unusual noise, the passion of fear is discoverable: with the growth of a child, other instincts and the

various passions unfold themselves like the buds of blossoms and flowers.

The brute creation affords innumerable examples of pure instincts. When caterpillars are shaken off a tree in every direction, all of them instantly turn toward the trunk, and climb up, though they had never formerly been on the surface of the ground. Young birds open their mouths upon hearing any kind of noise, as well as that of their mother's voice : they do not offer to use their wings till they feel the strength of them. Insects invariably deposit their eggs in situations most favourable for hatching and affording nourishment to their progeny. Water-insects never deposit their eggs on dry ground, and butterflies fix them upon such plants as are most agreeable to the palate and constitution of their young. Butter-flies which have been transformed in the house, exhibit marks of uneasiness when they cannot find a proper nidus for their eggs ; and when every other resource fails, they paste their eggs on the panes of the windows.

It would seem as if these instincts proceeded from a feeling of future wants. The bee and

the beaver construct magazines and fill them with provisions. The bees attend the female, or queen, and do her many little services. When deprived of the female, all their labours cease, till a new one is obtained, and then they renew their usual occupations. They make cells of three different dimensions, for the working bees, drones, and females. The queen bee, in depositing her eggs, distinguishes the three different kinds, and never puts a royal egg into the cells destined for the working bees. The number of cells is proportioned to that of the different bees to be produced, and a royal cell weighs as much as one hundred of the common kind. When there are several females in a hive, the bees work little till they have destroyed all the females but one; for, if more than a single female were allowed to remain in a hive, a greater number of eggs would be laid than the working bees are able to make cells for receiving. The intelligent Mr. Reaumur has, on that subject, made many experiments.

An instinct, quite different, we perceive in those bees, which build cylindrical nests with rose leaves. They first dig a cylindrical hole in the earth, and as soon as that operation is

finished, they go in quest of rose bushes, from the leaves of which they cut oblong, curved, and even round pieces, exactly suited to form the different parts of the cylinder. The wasp digs holes in the sand, and in each hole she deposits an egg. But how is the worm after it is hatched to be nourished? Here the instinct of the mother is remarkable. She does not feed upon flesh herself and knows not that an animal is to proceed from the egg, which must be nourished with other animals; yet she collects ten or twelve small green worms, piles them one above the other, and fixes them in the hole in such a manner that they cannot move. When the wasp is hatched, it finds ample food for its support till it is transformed into a fly, and is capable of procuring its own nourishment. Birds of the same species build, in every climate, their nests of the same materials, and in the same form, unless when restrained by peculiar circumstances. When removed by necessity from their eggs, they hasten back to them with anxiety. They turn their eggs, that they may be warmed on all sides. Ducks and geese cover up their eggs till they return to their nest. A hen sits with equal ardour upon eggs of a different species, or even upon artificial eggs. The swallow,

when her offspring are very young, carries their excrements out of the nest ; but, after they are older, she allures them to the side of the nest and teaches them cleanliness. The spider, and many insects of the beetle kind, run off with great swiftness when put in terror by a touch of the finger ; but, if they find that they are opposed on all sides, they seem to despair of being able to escape ; they contract their limbs and body, and counterfeit every symptom of death. In this situation they suffer themselves to be pierced with pins, or burnt, without their discovering the smallest mark of pain or of life, which perhaps may be ascribed to a stupor, occasioned by terror ; but, if the object of terror be removed, in a few seconds the animals run off with great rapidity.

Other instincts of animals seem to approach human reason, by their accommodating themselves to peculiar circumstances and situations. Those animals are most perfect whose sphere of knowledge extends to a number of objects : when interrupted in their operations, they know how to resume their labours, and to accomplish their purposes by different means. The falchion, the dog, and the fox, pursue their prey with great address. The ostrich

has been accused of unnaturalness, because she leaves her eggs to be hatched by the heat of the sun: but in Senegal, where the heat is great, she neglects her eggs only during the day, and sits upon them in the night. At the Cape of Good Hope, where the degree of heat is less, the ostrich, like other birds, sits upon her eggs both day and night. Bees, when they have room enough for their operations, augment the depth of their honey-cells: the female bee lays two or three eggs in each cell; but a few days after, when the cells are increased, the working bees remove all the supernumerary eggs, and deposit them in the new constructed cells. When a wasp, in attempting to transport a dead companion from the nest, finds the load too heavy, he bites off its head and carries it out in two portions. In order to elude the rapacity of the monkeys, in countries infested with them, many birds which in other climates build in bushes and the clefts of trees, suspend their nests upon slender twigs.

Finally, there are instincts which may be improved by experience and observation, and these are peculiar to man. We, indeed, perceive in some brutes a degree of docility

which excites our astonishment. A young dog, like a child, requires both time and art to unfold and perfect his natural instincts. The elephant, the horse, the camel, the cat, &c. may be taught many things that surprise us. We have heard of learned pigs, and even of learned geese. But the dignity of man is visible above all those learned animals. He, indeed, has some instincts in common with other animals, but he has more, and has such as by reflection and reason may be modified in a thousand different ways. The brute blindly follows the impulse of nature, but man follows the light that is kindled in his mind. And here the question arises, whether this light in the mind, *reason*, may be called *instinct*?

The superiority of man over the brutes is visible in the great number of instincts with which his mind is endowed by our Creator. Most animals are confined to very few instincts, and this appears to be the reason why their instincts are stronger and more steady in their operations than those of man. A being actuated by a great variety of motives, must necessarily reason or hesitate in his choice, must waver, and therefore appear to be inferior to another creature, who is stimulated to

action by a smaller number but by stronger motives. Hence, man has been considered as the most wavering and inconsistent of all animals. The actions of a dog or a monkey, for the same reason, are more various, whimsical, and uncertain, than those of a sheep or a cow. Most human instincts receive improvement from experience and observation, and are capable of a thousand modifications. One instinct often opposes another. Ambition or resentment often counteract the instinct of fear, and sometimes fear is too powerful for resentment. Anger is often restrained by the apprehension of danger, by contempt, the sense of propriety, and even by compassion: but anger and ambition frequently gain an ascendancy over sympathy, which is one of our most amiable instincts. The instinct or feeling of morality is often thwarted by ambition, avarice, fear, and other passions.

There are also modified, compounded, and extended instincts in man, and many of them are deviations from the two principal and innate instincts of love and fear. Thus, superstition is nothing but the instinct of fear extended to imaginary objects of terror. Devotion is the instinct of love, extended and

heightened by reason, to the first cause or author of the universe. Reverence for eminent characters is a species of devotion ; avarice is the instinct of love directed to improper objects ; hope, the instinct of love, directed to future good. Envy is compounded of love, avarice, ambition, and fear. Benevolence is the instinct of love diffused over all animated beings ; and sympathy is the instinct of love transfered to another person, and reflected back upon ourselves. In this manner all our passions and propensities may be traced back to their original instincts.

From all these examples the following general remarks naturally occur. Instinct therefore is, every natural endeavour to perform certain actions ; it is an original quality of the mind which, by means of the senses, produces certain feelings and actions, when the proper objects are presented to it : animal exertions, therefore, require sensation ; and whatever feels, is mind. Of course, the lowest species of animals are endowed with mind ; but their minds have different powers, and these powers are expressed by peculiar actions. Some instincts are coeval with birth, and are unaltera-

ble ; others are gradually unfolded by experience and the exigencies of the animal. One of the strongest instincts appears not till the age of puberty ; but by bad example and improper situations it may be prematurely excited. The instincts of brutes, as well as of man, are directed to their own preservation and the continuation of the species. But we must distinguish the instinct itself from the exertion or energy of instinct. Instincts exist before they act. What animals learn from the operations of instincts, cannot be called instinctive knowledge, but knowledge derived from experience and observation. But these qualities or instincts vary as much as the different classes of animals : some are endowed with many, and others with few : in some they are stronger, in others weaker ; and their strength or weakness is exactly proportioned to their number. The difference of talents among men who have had the same culture, arises from a bluntness or absolute deprivation of some original or modified instincts. Taste or love for particular objects, whether animated, inanimated, or artificial, is in some men so obtuse, that it seems to be entirely wanting. Insects have fewer instincts than quadrupeds, but their exertions are so uniform and steady that they excite the ad-

miration of every beholder. The structure of the body is uniformly adapted to the powers of the mind. An animal never attempts an action which nature has not enabled it to perform, by bestowing on it proper instruments. A bee collects the materials of honey and wax, but attempts not to gnaw rotten wood like the wasp. Even before the instruments of operation appear, the instincts of brutes exist. Calves push with their heads long before their horns are grown. There is as great, and perhaps a greater, difference between the mental powers of some animals than between those of man and the most sagacious brutes. Instincts may be considered as so many internal senses, which differ in number as well as in the degrees of perfection, and are peculiar to every species of animals.

The notion, that animals are mere machines, is absurd: for, though no animal is endowed with mental powers equal to those of man, there is not a faculty of the human mind but evident marks of its existence is to be found in particular animals. Senses, memory, imagination, the principle of imitation, curiosity, cunning, ingenuity, respect, gratitude, and even art, are discoverable in all the brute crea-

tion: they build in various styles; they dig; they wage war; they extract peculiar substances from water, from plants, and from the earth; they modulate their voices so as to express their wants, their sentiments, their pleasures and pains, their apprehensions of danger, and their hopes. Every species has its own language, which is understood among themselves: they ask and give assistance to each other: by their gestures and their sounds they express their thoughts. The same organization and the same feelings produce the same gestures and sounds. Birds and quadrupeds, therefore, are incapable of holding discourse with each other, or communicating the ideas and feelings they possess, in common. Some animals are capable of acquiring a knowledge of articulate sounds: they first judge of our thoughts by our gestures, and afterwards acquire the habit of connecting these thoughts with the language in which we express them. It is in this manner that the elephant and the dog learn to obey the commands of their masters. Infants in the same manner express their wants; different infants have different modes of expressing them, which the nurses perfectly understand, though they are unintelligible to strangers. Animals are not mere machines. A

machine is a select combination of the common properties of matter ; it would stand still forever, if it was not set in motion by some primary or other agency ; the regularity of its motions is a proof, that they are totally distinct from animal or spontaneous motion. A machine also has nothing analogous to sensation, which is the lowest characteristic of an animal. An animated machine, therefore, is an absurd abuse of terms. The instincts of brutes in general operate stronger, and are less subject to restraint than those of man : hence, they have often the appearance of acting by mere mechanical impulse ; and this circumstance has led some philosophers to consider brutes as machines. Children, savages, and ignorant men, act in the same manner as brutes : and it is society and culture only that soften and moderate the passions of men and of docile animals.

Brutes, like men, learn to see objects in their proper position ; to judge of distances and heights, and of hurtful, pleasurable, or indifferent bodies. Without some portion of reason, they could never acquire the faculty of making a proper use of their senses. A dog,

though pressed with hunger, will not seize a piece of meat in presence of his master, unless it be given to him ; but with his eyes, his movements, and his voice, he makes the most humble and expressive petition. Some animals soon after birth, like infants, know not how to avoid danger, or to make use of their members ; but experience soon teaches them what objects are hurtful, and what salutary. A young cat or a dog who never had leaped from a height, will without hesitation precipitate itself from the top of a high wall : but after perceiving that certain heights are hurtful, and others inoffensive, the animal learns to make the distinction, and never afterwards can be prevailed upon to leap from a great height. Young animals examine every object they meet with, in which they employ all their organs. The first periods of their life are devoted to study : when they run about and make frolicksome gambols, they exercise and improve their faculties and organs, and learn to distinguish the objects around them. Men, who in their youth have been prevented from mingling with companions and engaging in the amusements and exercises of youth, cannot use their organs and strength with ease or dexterity ; they are always awkward, and often

continue through life ignorant of the most common objects.

From all this the analogy of the brutes with man is apparent ; and that the superiority of the human intellect are necessary results, not of the confirmation of our bodies, but of the great variety of instincts which nature has conferred upon us.

The writings of professor Reimarus, on this subject, and the “Essays on the intellectual and active powers of man,” by professor Reid of Glasgow, may be read with utility and pleasure.

The former, professor Reimarus has not only with the greatest acuteness refuted the opinions of ancient and modern philosophers, of the artificial instincts of brutes, but has also thrown new light on this subject, and has shown the apparent true situation of those instincts from the peculiar structure of the body, the organs of sensation, and from a certain determined measure of the lower faculties of mind in brutes. He has thereby happily protected the human species against those philoso-

phers, who have ascribed to brutes the full power of reasoning.

Reason is the power of meditating on subjects, of comparing them, of drawing conclusions, and to be conscious of those thoughts, judgments, and conclusions. This power is, and will remain, the superior property and dignity of man. Were brutes possessed of the reasoning faculty ; were their arts and labours to proceed from meditation, experience, instruction, and gradual progress, as in the human species, it would necessarily follow, that they without any experience, could perform nothing of what many perform soon after their birth, for the preservation of their species. The spider spins its web, the ant digs its hole, before either of them ever had tasted a fly. The caterpillar becomes transformed without any knowledge of what is to become of him. the worm, proceeding from the egg in the cell, is scarcely transformed into a young bee, when it flies solitary to the fields, from one flower to another, sucks the nectar juice, returns richly provided to its hive, and performs all the functions which the economy of the bees require. What experience can the young bee have acquired of these things in so short a time ? If,

what brutes perform were the result of invention and reasoning, they would soon gain the advantage over man. How many years are not required before we acquire any knowledge of ourselves and the objects that surround us; before we, by repeated comparisons of things past and things present, become sensible of their analogy, or difference; and before we acquire a knowledge of the means and their application to gain our purposes? But how soon would not brutes arrive at the pinnacle of reason, were their actions the result of rational inventions? Who would believe that they, in so short a time, could acquire a knowledge so perfect of the most hidden nature of things? Discover to a pretended wit any of the wants of a brute, of which he does not yet know from observations, the means of supplying them; let him propose means from his own reason and experience; or show to him the artful work of an animal, of which he has not yet discovered the manner in which it was performed, and ask him how and wherefore it was made? How difficult he will find it to solve the question! Yet these wonderful artists, these animals, who in many cases betray faculties that surpass human reason, are in other things and actions stupid and ignorant.

The monkeys in America, who are so fond of sitting round the fire, after the persons who kindle it, have left it, why do they not fetch fresh fuel to continue the fire? they suffer the fire to extinguish and then leave it. Therefore, even this low degree of human invention is above their understanding; and it is a happy circumstance for man, that the power of reflection and invention in monkeys is thus contracted, or they would long ago have set the American plantations and forests on fire. A hen has so little power of distinguishing, that she will mistake a piece of chalk for her egg, and brood it. Were the brutes endowed with reason, they would be brought to a general and distinct knowledge of things, to the power of speaking, and to all the other advantages, whereby man is distinguished from them.... But they are deprived of all these advantages; they have no conception of things which lay beyond the circle of their sensual desires; neither have they any conception of time, numbers, proportion, beauty, the connection of things, of truth, virtue, or religion; nor are they possessed of the powers of speech. A monkey remains a monkey, and between him and the most ignorant of men there is still a greater distance than between the most igno-

rant man and a Leibnitz or a Newton. Were the brutes endowed with the reasoning faculty, their arts, like those of men, which result from reason and culture, would undergo changes ; they would rise and fall, and be more and more progressing to perfection. But the arts of brutes are as old as the world ; they are born with them ; they ever remain the same, and unimproved ; they require neither study nor practice, and continue from generation to generation. This is sufficient evidence that their instincts are implanted in them by the Almighty master-builder of the creation, himself ; that they are the necessary result of the organization and destination of their nature, and that man is a being, whose superiority over the brutes consists in his faculty of reason.

LOVE AND INSTINCT OF PROPAGATION.

THE great intention of nature, in endowing almost every animal with a sexual attachment, is a multiplication and continuation of the respective species. But to man, and in an inferior degree to all pairing animals, love is the source of many social and important advantages.

Love, or a strong affection for a particular woman, is to a young man one of the greatest incentives to virtue and propriety of conduct. In southern climates this instinct is stronger, and often degenerates into a passion, which totally unhinges the power of the mind. But in northern countries, it occupies more gently the imagination, and if reciprocal, diffuses over the mind and body a tranquility of disposition, which greatly contributes to the health and vigour of both. A young man in love, is constantly occupied in his mind with the object of his attention. Her image occupies his whole soul. He is in some measure deterred from regarding any other woman; and for her sake he suppresses any loose or irregular appetite. To behold her is his greatest pleasure, and to

possess her, the utmost of his wishes. With the female it is the same: she thinks of no one, dreams of no one, but the object of her tender affection. A young man and a young woman in love, exhibit the most innocent and most amiable picture in nature. How much is it to be lamented, that from the cruel, but perhaps unavoidable institutions and customs of civil society, it is often necessary to check, and even to overcome this powerful law of nature.

Mankind indeed, derive advantages from these institutions, and we should cheerfully submit to those hardships and inconveniences to which they give rise. Too early marriages among people in the dependant ranks of life are disadvantageous to the state. For, what is to become of the children? Therefore, it is of importance that the law of nature should yield among those people, for some time at least, to the institution of society, and to those prudential motives which parents learn from experience to be ingredients essential to the comfort and happiness of life. But it is as much to be lamented, that, whilst some give way too early to the instinct of nature, others suppress it or give it a baneful direction,...

Many men of fortune and independence sacrifice their taste, their passion, and often their happiness during life, at the shrine of gold: but, too many marriages are concluded by avarice and policy. But what are the consequences? not only that two persons are made wretched, but also that the happiness, the comfort, and the flourishing state of other families often become destroyed, and a successive degeneration takes place, which ends in their total extinction. Nature first chastises, and at last extirpates all those who act contrary to her established laws.

In man, and in all pairing animals, the natural love of offspring is a source of the most engaging endearments. The innocent and helpless condition of infants call forth our pity and protection. When a little farther advanced, their beauty, their smiles, and their sprightliness, excite the most agreeable emotions. In their progress from infancy to manhood, we observe with infinite pleasure the unfolding of their mental powers and their gradual steps from twilight to sun-rise and light. They imitate our actions long before they can express their desires by language.... Their attempts in the acquisition of language

are extremely curious and amazing. Their first system of grammar consists entirely of substantive nouns, and it is long before they learn the use of adjectives or of the verbs. Their speeches are short, awkward, and blundering, but this want of expression is supplied by the vivacity of expression in their eyes, and in the gestures of their bodies. After they acquire words sufficient for conveying the few ideas they possess, they begin to reason; but when they mean to give a reason why they should have any indulgence or gratification, they almost universally argue against themselves.... This excites laughter, and affords pleasure and amusement to the parents. The love of offspring is the strongest and most active principle in human nature. When in the year 1786, the Halsewell East Indiaman was wrecked in the English channel, on the coast of Dorsetshire, captain Pierce, who had, besides several other ladies, two of his own daughters on board, was informed that it was impossible to save the ladies, but that he might save himself. Upon which he enfolded his daughters in his arms, with these words: "Then, my dear children, we shall not part; we shall perish together!" and in a few moments the

ship with every person on board was buried in the deep.

In the brute creation this instinct is as strong. A bitch, during the operation of dissection, liked her young, whose presence seemed to make her forget the most excruciating tortures; and then only uttered the most dolorous cries when she perceived that they were removed. Certain species of spiders carry their eggs in a silken bag upon their backs, and are extremely nimble in their motions as long as they feel that sweet burden; but as soon as the bag is forced from a spider of this kind, she falls into a languid state. The deer exposes herself to the cruelty of the chasing dogs, to prevent them from attacking her fawn.

It is well known in what manner the pigeon feeds her young. A cow, placid and phlegmatic as she is by nature, becomes vigilant, active, and even ferocious, in the defence of her calf. A lioness, deprived of her young, presents the most dreadful picture of anxiety, rage, and rapacity. A hen becomes as bold as a lioness, as soon as her chickens are hatched. When her young appear to be in danger, she bristles up her feathers, makes an alarming

noise, and attacks every animal that comes near her. Though several of the insect tribes are ignorant of the existence of their progeny, because, in general, the parents die before the young are hatched, yet they uniformly deposit their eggs in substances which afford to the young immediately after their escape from the egg, nourishment and protection, and thus the great purposes of nature, namely, the continuation and happiness of her productions, are accompanied by different means. The effects of these laws or instincts in nature we perceive, but the causes, or the modes by which they operate on animal minds, are inscrutable. Pleasure is certainly attached to all the functions of animals; but this pleasure cannot be the original cause; for the animal must first learn from experiment whether the result of any particular action is to be agreeable or disagreeable. Nature seems to have bestowed on the minds of all animated creatures a number of laws or instincts perfectly accommodated to the species, and which irresistibly compel them to perform certain actions: we must admire, but we can never penetrate the mysteries of nature. The causes of that strong and mutual attachment between parents and their offspring may be explained from the circumstance, that

in man, quadrupeds, and birds, the mother is fond of her young, because the action of sucking or hatching affords to them a pleasant sensation and a cherishing warmth. But still this is only the effect, and not the original cause of instinct. In brutes, parental and filial affection ceases whenever the young are able to provide for themselves.

With regard to man, marriage is a selection and unalterable connection of a male and female. Each uncorrupted young man will look out for a female, and choose according to his taste. This universal and almost irresistible impulse of free selection, in both sexes, is the strongest argument in favor of monogamy, or the union of pairs, among the human species ; and, beside this forcible impulse, the males and females produced, are nearly equal. The tyrants in the oriental parts of Europe, of Asia and Africa, who keep seraglios, offend the laws of nature, but they are thereby deprived of all that happiness and pleasure, resulting from the coincidence of sentiment, from the mutual love of parents and children, and the confidence between man and wife.

All those species of animals, whose offspring require, for some time, the industry and support of both parents, are endowed with the instinct of selection, or of pairing. Among the feathered tribes, pairing is almost universal. The young of all kinds, continue for some weeks in a weak and helpless condition. The mother not being provided with organs fitted to secrete milk, she is unable to nourish them out of her own body. She is therefore obliged to go abroad in quest of food for them. But the progeny often are so numerous, that all her industry would be ineffectual, if she were not assisted by the father. And this parental care and attachment continues till the young have acquired sufficient strength to provide for themselves. Eagles, and some other birds of prey, continue faithfully in pairs for years, and perhaps during life. These facts afford a strong argument in favor of single marriage, or a man marrying but one woman. For as the children of men remain in the infant and helpless state longer than any other animal, and no mother could, with her own industry, possibly suckle and procure nourishment for a numerous family, the assistance of the father, as in the feathered tribes, becomes indispensable. It is a remarkable fact, that the male of most

birds not only selects a female, but with great assiduity brings food to her when siting on her eggs; and often relieves her by siting on them himself.

Herbivorous animals, or those that feed upon grass, the roe-deer excepted, do not pair; because their young, very soon after birth, can eat grass or other vegetables. Lions, tygers, wolves, and other rapacious quadrupeds, do not pair; but the whole labour of procuring food is devolved upon the female, which often shortens her own life as well as that of her offspring: this, however, is a fortunate circumstance for man, to whom a too great multiplication of those destructive species would become extremely dangerous. The beaver abandons the whole stock of provisions they have laid up, to the female, as soon as she has produced her young, and goes in quest of food for himself, but frequently returns and visits her while she is suckling her young. They pair in autumn, and bring forth their young in January, when all their magazines of provisions are well stored. It is a wise arrangement in nature, that the bringing forth, or hatching of most animals, not excluding the insect tribes, uniformly takes place at those

seasons of the year when the nature of the weather, and the food peculiar to the species, are best adapted to the constitution of their offspring. Caterpillars of every kind are never hatched till the various plants on which they feed, though they grow in different months, have put forth their leaves.

INSTINCTS OF ANIMALS IN CONSTRUCTING
THEIR HABITATIONS.

MANY animals are architects by nature: they possess the faculty to construct proper habitations for concealing themselves, for defending them against the attacks of their enemies, for sheltering and cherishing their young, and for protecting them from the injuries of the weather. Those of the same species uniformly build in the same style, and use the same materials. Man only deviates from this uniformity, and builds a cottage or a palace as his taste or fancy shall direct him. In treating of this subject, however, we confine ourselves to the architecture of the inferior tribes of animated beings, who dig holes in the earth, or construct cells and habitations. But the artifices they apply, the materials they make use of, the situations they choose, are so numerous and various, that we only will treat of those that seem to be the most remarkable.

The Alpine marmots, who have some resemblance both to the rat and to the bear, retire into their holes the beginning of October,

where they remain in a torpid state during winter, and never come abroad again till the beginning of April. They form their retreats with much art and precaution in the form of a Y, each branch of which has an aperture.... One of these apertures is a kind of aqueduct, to carry off the water and the excrements of the animals; the other is used for coming in and going out. Several of them live together, and their place of abode is well lined with moss and hay. During summer, they work in common at their habitations. One of them stands centinel upon a rock, while the others are employed in cutting grass, in order to make hay. At the approach of a man, an eagle, a dog, or other dangerous animal, they, at a signal of the centinel, immediately run to their holes. When they feel the first approaches of the sleeping season, they shut up both passages to their habitation with such solidity, that it is more easy to dig the earth any where else than in such parts as they have thus fortified. At this time they are very fat, but at the end of winter they awake extremely emaciated. If taken during their winter sleep, they revive by a gradual and gentle heat.

The republican society of the beavers, and the art with which they build their habitations on the borders of rivers, sea-port towns, and villages; the harmony in which they live together, the precautions they use against danger, and every other circumstance respecting them, is fully described in Buffon's natural history. However powerful, wonderful, and incredible, the proceedings of these animals seem to be, they are so well confirmed by experiment and eye-witnesses, that the narration of it cannot in the least be doubted.

The almost similar manner in which the moles construct their habitations, is well known and may easily be seen and examined.

The nests of birds have, as inimitable pieces of architecture, at all times deservedly called forth the admiration of mankind, and they excite even the surprise of children. Birds of the rapacious tribes build their nests of coarse materials, in elevated rocks, ruinous and sequestered castles and towers, and in other solitary retirements; but they line them with soft substances. The nest of the eagle is large and flat, and serves him, it is said, during life. Some suspend their nests between branch-

es of trees, to preclude the monkeys and other enemies from injuring them. Most of the smaller tribes build their nests in hedges, shrubs, or bushes, in so artful a manner, as entirely to conceal them from the observation of man. On the sea coast of China, a sort of small birds, of the shape of swallows, build their nests from a certain clammy, glutinous foam or froth of the sea-water, dashing and breaking against the bottom of the rocks, which the Chinese pluck from the rocks, and carry in great numbers into the East Indies to sell. When dissolved in chicken or mutton broth, they are esteemed by gluttons as great delicacies, preferring them before oysters, &c. The storks build their nests on churches or on the tops of houses. Birds uniformly proportion the dimensions of their nests, to the number and size to be produced.

The manner in which insects build their habitations, whether solitary or in society, equally excites our admiration. There are several species of bees, called solitary bees, because they do not associate to carry on any joint operations. They fix their nests to the walls of houses, into pieces of wood, decayed

trees, or into the earth ; they form cells one above the other, in each of which they carry some farina of flowers moistened with honey. Into this paste, which is to nourish the future worm, they deposit their eggs. The bee in the undermost cell, is the oldest, and soonest transformed ; therefore, if it were to force its way upward, it would not only disturb, but infallibly destroy all those lodged in the superior cells. But nature has wisely prevented this devastation ; for the head of the fly is always placed in a downward direction, so as to find in succession an easy and convenient passage. Other animals provide for their young after birth ; but these bees show as much tenderness in their care for their expected offspring. We see all these effects ; but our reason cannot discover the cause. Des Cartes, Buffon, and other philosophers, have had recourse to confirmation of body and mechanical impulse, in order to solve this problem. But their reasonings involve the subject in tenfold darkness. It is better, therefore, to refer the operations of animals to pure instincts, or original qualities of mind, bestowed upon them by HIM, who has formed all nature with infinite wisdom for the great purpose of preserving and continuing the different species. If in a chain of

reasoning we loose sight of an ultimate cause of all things, we find ourselves clouded in obscurity, for which we will be branded with absurdity by men of a more correct and unprejudiced mode of thinking. The world is justly obliged to M. De Buffon for the industry he employed, in examining and describing the architecture of bees, especially of the gregarious tribes, who form republican governments with such wisdom and harmony, as would baffle men to imitate: but, we cannot agree with him in ascribing the cause to mechanism. From matter, nothing like mental faculty can proceed. The hexagons, or six-sided figures of their cells, whereby no void spaces are left between them....the exact distribution of the labour among them, so that in the hive no one interrupts the other....the securing the outside against the stings of insects....the killing of every enemy that approaches the inside....the removal of all dead matters subject to putrefaction....the submission to the queen, whom they exalt to the throne themselves....the care for their eggs from which their posterity are to proceed....the gathering of the farina of the flowers, the honey, and of the wax; and a thousand other remarkable circumstances in the republic of these industrious animals, are

so intricate, and yet measured with so much exactness, with so much regularity and art, and all their operations are so much to the purpose, that it would be an offence to human reason, to ascribe the effects to the mere connection of parts of matter, or to mechanism.

Wasps are insects who do not, like the bees, live by their own industry. They are ferocious, and live entirely on rapine and destruction. They kill every insect that is inferior to them in strength, but are peaceable among themselves, and construct their nests to one common purpose. Those who conceal their nests under ground, have two holes for passages to the combs. They uniformly enter by one hole, and go out by the other, in order to prevent confusion in their common labour.... Their nests consist of several stories, ranged paralelly above each other, and every story is composed of a number of hexagonal cells, regularly constructed with a matter resembling ash-coloured paper, which they prepare themselves. But, as their mysterious manner of building is performed under the earth, it is difficult to discover it. M. de Reaumur, however, with much industry, contrived to make wasps, like the honey bees, lodge and work in

glass hives. They do not sting, unless they are irritated. The materials of which they build their habitations, are small fibres of wood, which, by means of a glutinous substance furnished from their own bodies, they form into a moist and ductile paste. Of this substance they construct the external cover, the partitions, the cells, and the columns, which support the several stories of combs. They feed the worms that proceed from the eggs, as birds feed their young, till their transformation takes place. While the working wasps are occupied at home, the others are abroad in quest of food, which they carry home, and those employed in the different operations share it peaceably. As soon as the worm is transformed into a wasp, it breaks through its cell, which immediately after is cleaned and repaired by an old one, for the reception of another egg.... The wasps of different sexes differ greatly in size, and these animals know how to construct cells proportioned to the dimensions of the fly that is to proceed from the egg. They carry out such of their companions as happen to die, and, when the load is too heavy, they cut off the head, and transport the animal at two times. At the beginning of autumn, they cease feeding the worms or the young; they carry

them out of the cells, expose them to the air, and any enemy, or kill them themselves. But this seeming cruel proceeding is in reality benefaction; for as they do not lay up any honey or other store for winter, the young would perish in a more miserable manner. Before the end of winter most of the females die; the few that survive are destined for the continuation of the species. This destruction of the wasps is a wise arrangement in nature; for, as they multiply so fast that thirty thousand can live together in a hive, such an enormous number of them would at last exist as to annoy and even destroy men and brutes.

OF THE HOSTILITIES OF ANIMALS.

By an established law of nature, every thing on our planet is subject to devastation, destruction, and death. There is not perhaps a single species of animated beings whose existence depends not, more or less, upon the death and destruction of others. Animals who have a determined period of existence, if not deprived of it by accident, or by the hostility of others, are impelled to devour different species, and sometimes their own. In the system of nature, death and dissolution seem to be indispensable for the support and continuation of animal life. This in particular relates to those species which are distinguished by the appellation of carnivorous or rapacious, of whom we shall mention some examples, and then point out such advantages as result from this apparently cruel institution of nature.

Of all rapacious animals, man is the most universal destroyer. His rapacity has hardly any limits, and his empire over the other animals is almost universal. He either subjects and enslaves, or devours every species. Of some of the quadruped tribes, as the horse, the

dog, the cat, he makes domestic slaves, and he either obliges them to labour for him, or keeps them as sources of pleasure and amusement. From the ox, the sheep, the goat, and the deer kind, he derives innumerable advantages. The ox, or the cow, after receiving the emoluments of their labour and fertility, he rewards with death, and then feeds upon their carcasses. Many living beings are daily massacred in millions for the purposes of commerce, luxury, and caprice, and myriads of animals are annually destroyed for the sake of their furs, their hides, their tusks, their odoriferous glands, &c. There is not a single species in the numerous class of birds which he does not employ in a similar manner either for his nourishment or his amusement. He domesticates those of the more prolific and delicious species. He multiplies them without end, and devours them at pleasure. The rivers, lakes, and even the ocean itself, feel the power of his empire, and are forced to supply him with fishes. Neither air nor water can defend against the ingenuity, the art, the destructive industry of the human species; and even in artificial ponds he domesticates fishes for the use of his table. It might have been expected that some of a disgusting aspect, as the crab, the oyster, the tur-

tle, &c. would not have excited the human appetite ; yet in every region of the earth, many insects which inhabit both the earth and the waters, are esteemed as delicate articles of luxury.

All this, however, evinces the dignity and the vast superiority of the intellect of man over that of the most sagacious of brutes ; though even his power is in many respects very much limited. Some species elude his power by the rapidity of their flight, or the swiftness of their course ; by the obscurity of their retreats, and by the element in which they live, or by the minuteness of their bodies. Others, instead of acknowledging their sovereign, boldly attack him with open hostility. He is insulted and injured, even by the stings of detested insects, and by the poisonous bites of serpents. Man cannot influence the motions of the heavenly bodies, or the revolutions of the globe which he inhabits ; for every order of beings moves on in its own course, by that irresistible power which produced all nature. Neither has he a general dominion over animals, vegetables or minerals. He cannot prolong his own existence at pleasure, but is hurried along by the general torrent of time and of nature. He is

obliged to submit to the universal law, and like other organized beings, he is born, grows to maturity, and dies. If he has by the superior powers of his mind, subdued the animal creation, he could not make proper use of his empire previous to the institution of societies. It is society only that matures his reason, gives exertion to his genius, and unites his forces. Before the formation of societies, man was perhaps the most helpless, and the least formidable of all animals. Naked and destitute of arms, to him the earth was only an immense desert, peopled with rapacious monsters, by whom he was often devoured. History informs us, that even long after the formation of societies took place, the first heroes were destroyers of wild beasts. In proportion as societies, the arts, and culture increased, the wild beasts were forced to retire to the desarts. He cleared the earth of those gigantic animate who perhaps now no longer exist, but whose enormous bones are still found in different regions, and are preserved in the cabinets of the curious. The numbers of the voracious and noxious species became reduced, and the powers and the dexterity of one animal was opposed to those of another. Some were subdued by force, and others by address. In this

manner, man in process of time, acquired to himself perfect security, and an empire that has no other limits than inaccessible solitudes, burning sands, frozen mountains, obscure caverns, and other places, which are occupied by the most ferocious animals, and whither he cannot follow them.

Among the carnivorous quadrupeds, some are the most rapacious and destructive. The lion, the king of the animals, kills no more than he is able to consume. But the tyger is grossly ferocious, and cruel without necessity. He is perpetually thirsting for blood. He desolates every country that he inhabits, and dreads neither the aspect nor the arms of man. The Hindoos however, have used themselves to a sure method of killing tygers. They in their attack fix their eyes steadily upon him and direct the spear in such a manner that the tyger, when he makes a leap at them, encounters the point of the weapon, and meets with destruction. The tyger sacrifices whole flocks of domestic animals, as well as all the wild beasts which come within the reach of his terrible claws. He attacks the young of the elephant and rhinoceros, and sometimes even ventures to brave the lion. He often devours his own young,

and tears their mother in pieces when she attempts to defend them. He is perhaps the only animal whose ferocity is unconquerable. With harsh or gentle treatment he is equally irritated. His ferociousness increases with his age. He tears, with equal wrath the hand which feeds him, as that which is raised to strike him. He delights in blood, and gluts himself with it till he is intoxicated.

The wolf, in temperate climates, exceeds all other animals in ferocity and rapaciousness: when pressed with hunger, he braves every danger, and attacks not only those animals which are under the protection of man, as lambs, kids, and dogs, but also wild beasts, and even men, women, and children. Wolves are fond of human flesh, and they have been known to come in troops to the field of battle, to tear up the bodies that have been carelessly interred. Whole countries are sometimes obliged to arm, in order to destroy the wolves.

Almost every bird is a bird of prey; for they either devour every fly, worm, or insect, or carry them to their young; but most of those that are properly called birds of prey, live upon fishes. It is to be observed, however, that

birds of prey, like rapacious quadrupeds, are not so prolific, as the milder and more inoffensive kinds. They often, when their hunger becomes excessive, expel their young, or kill them. They never associate, and, like robbers, lead a solitary and wandering life. They pair, partly from instinct, and partly for giving mutual assistance in making war against other animals; but they never assemble in flocks, nor even associate in families. Those birds and quadrupeds which are nourished by the productions of the earth, live in families and fields, and assemble in numerous flocks without quarreling or disturbing one another.

All the inhabitants of the waters live upon rapine. Every fish, from the smallest to the largest, is in constant motion either to devour others, or to avoid an enemy. Their appetite for food is so insatiable that they greedily swallow every thing that has the appearance of animation. Those that have small mouths feed upon worms and the spawn of other fishes; and those whose mouths are larger, devour every animal, their own species not excepted, that can pass through their gullet. In the shallows, the oyster lies in ambush at the bot-

tom, with her shells open, and, when a small fish comes in contact with her, she instantly closes her shells upon him, and devours at pleasure her imprisoned prey. Neither is the hunting or pursuit of fishes confined to particular regions; for, shoals of one species follow those of another through vast tracts of the ocean. It is a remarkable circumstance in the history of animated nature, that, though all carnivorous birds and quadrupeds are less prolific than the associating kinds, the inhabitants of the waters, who are all carnivorous, are endowed with a most astonishing fecundity.... One single roe sometimes contains millions of eggs. Were they all to arrive at maturity, the ocean in a few centuries would not be spacious enough to contain its animated productions. But this wonderful fertility answers the purposes of furnishing their numberless enemies with food, and of continuing the respective species.

Among the insect tribes the system of carnage is the greatest. One species devours another. The spiders sacrifice the flies, and in return, spiders are devoured by another kind of flies, called ichneumons, who also make great havoc upon caterpillars and other in-

sects that are pernicious to the fruits of the earth. The wasps kill the flesh-flies. Caterpillars have the most enemies, and they kill and devour each other. An oak tree contains millions of caterpillars, and also a vast number of beetles, who live upon caterpillars.

But, beside the general system of carnage produced by the necessity of one animal's feeding upon another, there are other motives for destruction. Men, by waging war, often destroy themselves, because they want to derive advantage at the expence or the ruin of others. This is unnatural ; for, if universal peace could be completely established, and if all men lived in harmony, and cultivated the earth to the highest perfection, it is not probable that the multiplication of the human species would ever rise to such a degree as to exceed the quantity of provisions produced necessary for their existence and happiness. Among the laws of polished republics, we find some which are extremely barbarous. The Lacedemonians were allowed to kill such of their children as were produced in a defective state, because they would become a burthen upon the community, and it is said, that the laws of the Chinese permit actions equally inhuman. But instances of this kind

we meet with in the brute creation. A hive of bees consists of a female, of males, and of neuters, and there are times when the neuters cruelly massacre the males, because they had become useless to the community. Mortal combats are not unfrequent between bees belonging to the same hive, and these combats never terminate but by the death of one of the parties. Whenever a strange bee enters the hive, his temerity is uniformly punished with death.... In the swarming season, general actions are not unfrequent, which never terminate without great havoc on both sides.

But why is nature formed thus? why this cruel necessity that in the connection of all things no animal can live without the destruction of another? wherefore so much devastation and death in all animated nature?....No mortal can solve this question; who can unfold the mysteries of nature, but the Almighty author of all things? We will, however, before we finish this subject, endeavour to point out the utility and advantages resulting from this institution of nature, which may have a tendency to reconcile our minds to a system so destructive to individuals of every species, and to enable us to draw some conclusions of

the wise intentions of the great author of nature. Nature seems almost indifferent to individuals who perish every moment in millions, but with regard to the whole system and to species of every description, her uniform attention to the preservation and continuation of all animated beings, is conspicuous and merits admiration. Life, it would appear, cannot be supported without the intervention of death. Through almost the whole of animated nature, nothing but rapine and destruction prevail. This, however, has its use. Every animal, after death, administers life and happiness to a number of others. Many animals, if deprived of animal food, could not exist. Their structure, and especially their powers of digestion and of assimilation, are confined to animal substances. This observation, indeed, is applicable solely to the carnivorous tribes; but even herbivorous animals, or those that feed upon vegetables, daily devour thousands of insects. This may be the reason why cattle of all kinds fatten so remarkably in rich pastures; for insects are always most numerous where the herbage is luxuriant. Nature is so profuse in her animated productions, that no food can be eat, and no fluid can be drank, in which ani-

mal substances either in a living or dead state are not to be found.

The hostilities of animals, mankind not excepted, give rise to mutual improvement. Those animals who are surrounded with many enemies, are endowed with a superiority of parts in proportion to the number of enemies they have to attack or evade. The weak and timid animals are obliged to exert their utmost powers in inventing and practising every possible mode of escape. It is pure instinct that powerfully prompts them ; but this instinct becomes improved by experience. Rapacious animals, on the contrary, by frequent disappointment are obliged to provide against the cunning and alertness of their prey. Herbivorous animals are stupid, but they would be still more stupid, if they had no enemies to annoy them. Man, if his attention and talents were not excited by the animosities of his own species, by the attacks of ferocious animals, and even by those of the insect tribes, would be an indolent, an incurious, a dirty, and an ignorant animal. We learn from a multitude of travellers and voyagers, that those islanders who procure their food with little or no industry, are perfectly indolent and brutishly stupid.

Timid animals never defend themselves, except from three causes....pure instinct, which is implanted in their natures, imitation, and experience. Even flight is instinctive ; but the modifications of it are acquired by imitation and experience.

The third intention of the author of nature seems to be a profusion of animal life. Is it not a highly pleasing idea, that at every moment innumerable creatures on every part of the globe, enjoy life, and are, each in its nature, happy? It would be the height of selfishness to consider all these creatures as nothing. We may kill them for our use ; but we dare not torment them. Those that are noxious we may endeavour to extirpate ; but in the chain or connection of all things, they are necessary members. To support myriads of animated beings with food, nature uniformly covers the surface of the earth with trees and vegetables of every kind, when not modified or restrained by the industry and intelligence of men. But if all animals were to live upon vegetables alone, millions of creatures, which now enjoy life and happiness, could have no existence ; for the productions of the earth would not be sufficient to support them....

Therefore, by making animals feed upon each other, the system of animation and happiness is extended. Nature, in this view, is not cruel, but highly beneficial. The ox, the sheep, the goat, and other animals, which are under the peculiar protection of man, are daily used for food. Man has a right to eat them. The timid and docile race of animals, if they were not cherished and defended by man, would be devoured by rapacious quadrupeds and birds of prey; and though the species might perhaps be continued, the number of individuals would be very small. Therefore, though man occasionally destroys domestic animals, he gives life to millions, which, without his aid, would have no existence.

Beside, there is a wonderful balance in the system of animal destruction. If all the various and numberless animated beings of nature, had no other check, than the various periods to which their lives are limited, the whole would soon be annihilated by an universal famine. If even a single species were permitted to multiply without disturbance, the food of other species would be exhausted, and, of course, a period would be put to their existence.

By the carnivorous animals, the herbivorous are prevented from increasing to a hurtful degree. What in the vegetable kingdom is necessarily done by the hoe and pruning-hook, the carnivarous tribes perform in the animal kingdom. By diminishing the number of plants when too close, or lopping off their luxuriances, the others grow to a greater perfection. To those swarms of insects which cover the surface of the earth, an active and vigilant army of birds is opposed. Hares, rabbits, mice, rats, &c. are exposed to the depredations of carnivorous quadrupeds and birds. Man, by the superiority of his mental powers, maintains in a high degree the balance and empire of the animal system. Those species which multiply the most, such as the caterpillar, have the greatest number of enemies. No species, however, is ever exhausted. The balance between gain and loss is perpetually preserved. The earth, the seas, the atmosphere, is a constant and immense scene of pasture. There exist without interruption, animals in abundance as provisions for others. Every animal and every vegetable furnish subsistence to particular species. Nothing remains; and nothing of value is lost.

The economy that reigns throughout all nature, excites our admiration. After an inundation of the Nile, the lower parts of Egypt are greatly infested with serpents, frogs, mice, and other vermin: but about that time, the storks resort thither in immense multitudes and devour the serpents, frogs, and mice. If the storks did not destroy the amazing numbers of vermin which appear in that country, the land could not be inhabited. The Egyptian vulture is of singular benefit to that country. It eats up all the offal in the towns, and the carcasses of camels, horses, asses, &c. in the fields which, if not quickly devoured, would, in that warm climate, be productive of pestilence. The bear, the wolf, the fox, the dog, the raven, are in this respect, equally useful. The swine greedily devour serpents; wherefore the new settlers in the uncultivated parts of America, pay great attention to the keeping of those animals. The smaller birds, and especially their young, live upon caterpillars; and by devouring them, these birds preserve the fruits of the earth from total destruction. Sparrows, therefore, are much more useful than noxious. The number of caterpillars they daily destroy, greatly overbalances the damage they do in gardens themselves. Mr.

Bradley, from actual observation, has proved, that a pair of sparrows, during the time they have their young to feed, destroy every week 3360 caterpillars, daily 480, and hourly 40. They likewise devour butterflies, and other winged insects, each of which, if not destroyed, would be the parent of several hundreds of caterpillars. The sword-fish is a dangerous enemy to the whale, who, though comparatively small, often attacks and even succeeds in killing the whale. When the sword-fish, with the sharp points or teeth with which it is provided near the snout, attacks the whale, the sea is dyed red with the blood issuing from the wound. The whale then becomes furious, which appears from the vehemence with which it lashes the waters, each stroke resounding like the report of a cannon. In short, nature does nothing in vain. No animals exist which are not useful either by affording nourishment to, or preventing the hurtful increase of, other species. There is in nature a circle of animation and of destruction, perpetually going round.

OF THE ARTIFICES OF ANIMALS.

THE love of life, and of self-preservation, implanted in all animals, the desire of multiplying the species, and the attachment which every animal has to its offspring, are the sources from which all the movements, all the dexterity, and all the sagacity of animals originate ; the principle of self-preservation gives rise to innumerable arts of attack and defence. The horses rank up in lines, and beat off the enemy with their heels. The monkeys in Brazil, while they are sleeping on the trees, have uniformly a centinel to warn them of the approach of rapacious animals, and the same precaution they use, when they are committing depredations on the fruits of a garden. The deer kind are remarkable for the arts they employ in order to deceive the dogs. They often return twice or thrice upon their former steps, to draw off the attention of the dogs ; they swim through waters to cut off the scent from the dogs, and at last defend themselves with their horns against their surrounding enemies. The turnings of the hare are extremely artful, and the fox has, in all ages and nations, been celebrated for craftiness and address. He is

acute, circumspect, sagacious, and prudent, and always reserves some art for unforeseen accidents. He takes up his abode on the border of a wood, and in the neighbourhood of cottages. Here he listens to the crowing of the cocks and the noise of the poultry. He scents them at a distance. His time of attack he chooses with great judgment and discretion, in the depth of night. Early in the morning he visits the nets of bird-catchers, and carries off successively all the birds that happen to be entangled. He hunts the young hares, seizes the old ones in their seats, digs out the rabbits in the warrens, finds out the nests of partridges, quails, &c. and greedily devours flesh, fishes, eggs, milk, cheese, fruits, and especially grapes. When pursued he runs to his hole, where he, however, is often killed by the hunters or seized by them alive. Instances we know of, that foxes and even hares have concealed themselves among flocks of sheep. The fox is so extremely fond of honey, that he attacks the nests of wild bees. The birds have such an antipathy against him, that they no sooner perceive him than they send forth shrill cries to advertise their neighbours of their danger.

There is a species of rats in Kamschatka which make neat and spacious nests underground, and divide them into different departments, in which they deposit stores of provisions for winter, and which they never touch till they cannot procure nourishment any where else. It is worthy of remark that these rats, like the Tartars, change their habitations, and sometimes not only abandon them, but all Kamschatka, for several years. Their retreat always alarms the inhabitants, which they consider as a presage of a rainy season, and of a bad year for hunting. They return in such prodigious numbers that travellers are obliged to stop till the whole troop passes ; and whenever they appear, the happy news is soon spread over all parts of the country.

Rapacious birds uniformly endeavour to rise higher in the air than their prey, that they may have an opportunity of darting forcibly down upon it ; but the smaller birds, by their perpetual changes of direction, know how to avoid their attacks and to render them fruitless. These smaller birds also conceal themselves in hedges or brush wood, and have been often known, in the extremity of danger, to fly to men for protection. The ravens often frequent

the sea shores in quest of food, and when they find their inability to break the shells of muscles, they carry a muscle or other shell-fish high up in the air, and then dash it down upon a rock, by which means the shell is broken, and they obtain their object. Our knowledge of the economy of fishes, is extremely limited, yet we know the ocean exhibits a general scene of attack and defence, and that of course the arts of assault and of evasion, must be exceedingly various. The spider spins his web, for the double purpose of an habitation and of a machine for catching flies for his food, and the spider with great patience lies in the centre of his web for days and weeks, till a fly happens to be entangled. The ants have their enemies among the insects, birds, and animals. The *formica leo*, or ant-lion, digs a hole in the sand as a snare, in the form of a funnel, at the bottom of which it lies in ambush for its prey, especially for small ants, which is its favorite food. When arrived at its full growth, the ant-lion gives up the business of an ensnaring hunter, spins a round silken pod, and is soon transformed into a fly.

OF THE SOCIETY OF ANIMALS. -

NATURE and want produce society. The first natural condition of mankind is the union of a male and female : these produce a family, who from parental or filial affection continue together, and assist each other in procuring food and shelter : this family soon feel their own weakness, and their inability to supply their wants ; they meet with another family in the same condition, and they unite for mutual support and protection : a large number of such families united, form a nation. It is extremely probable, that in countries thinly peopled with savages, societies have been formed by the gradual union of families and tribes : the increase of power arising from mutual assistance, and many other circumstances, soon contribute to cement more firmly the associated members ; the invention of an individual soon becomes general, and in this manner gradual advances are made from the savage to the civilized condition of mankind. This is the origin of society, and to such a state nature has destined man. The instinct of social intercourse is not acquired by education or habit : the child upon the breast, when another

child is presented to it, exhibits the most evident expressions of joy ; when farther advanced, they daily mingle and sport together : without pride or artful distance, the prince plays with the peasant's son, and friendships and inclinations formed in youthful days, when the natural affections are unbiassed by selfish and vicious motives, frequently continue during their lives. Man is by nature an associating or gregarious animal.

The advantages we derive from association are great. Man, beside the reasoning faculty he possesses, enjoys the power of communicating and expressing his ideas by articulate and artificial language, whereby the bonds of society not only are drawn closer and rendered more agreeable, but this prerogative also becomes the greatest source of improvement to the human intellect. If mankind were to associate without artificial language, what an humiliating figure would they exhibit, even upon the supposition that they might, by the mode nature has bestowed upon every animal, be able to express their wants, pleasures, and pains ! But when language and association are conjoined, the human intellect arrives at a

higher degree of perfection, and this gives rise to virtue, honor, government, subordination, arts, science, order, and happiness. All the individual members of society conduct themselves upon a regulated system. Under the influence of established laws, governments are enabled, by the exercise of legal authority, to encourage virtue, repress vice, and to diffuse, through the extent of their jurisdictions, the happy effects of their administration. In society only, as in a fertile climate, human talents can germinate and become expanded; the mechanical and liberal arts flourish; poets, orators, historians, philosophers, lawyers, physicians, and theologians are produced; and a well regulated state is a never-failing source of happiness to the individual members. But through the whole extent of nature, it seems, that good and evil are necessary concomitants. Immense as the advantages of society are, the inconveniences, hardships, injustice, oppressions, and cruelties, which too often originate from it, are equally great and lamentable. Even under the mildest and best regulated governments, we observe animosities, jealousies, avarice, fraud, and chicanery. But misery, poverty, and cruelty, seem to take their abodes particularly in absolute monarchies and

despotic governments. However, any government is preferable to anarchy ; and the comforts, pleasures, and improvements we receive from society, overbalance all the evils it produces.

Society comprehends all those men and other animals, who not only live together in numbers, but carry on certain operations which have a direct tendency to promote the welfare and happiness of the community. Without society man would not be able to effect any operation, or shew any great superiority of talents, above those of the brute creation. A single family, or even a few families united, might procure a sufficient quantity of food. They might, like the bear, lodge in cavities of trees, or occupy natural caves in the rocks, or even build huts with branches of trees. There are in many parts of the world, savages in existence, who can do no more. It is by regularly established societies alone that the germs of human intellect are expanded and brought to perfection. What is the hut of a savage to the palace of a prince ? or what his canoe, when compared to a first rate ship of war ? Next to man, the beaver is the most conspicuous animal, by his love for society, and

by his operations in preparing materials and building winter habitations. When we read the history of the beavers, we are apt to think that we are perusing the history of man in a period of society not inconsiderably advanced. In a solitary state, the beavers, like solitary savages, are timid and stupid animals. In the northern parts of Europe they are so perpetually hunted for the sake of their furs, that from a necessary attention to individual safety, they have no opportunity of associating. But in the remote regions of North America, where they can carry on their operations without being disturbed, their association is a kind of republic, and indeed a society of peace and affection. They never quarrel or injure one another. The inhabitants of the different cabins, as well as those of the whole village, have no chief or leader. The principle of their union is neither monarchical nor despotic. They live in harmony, and their association is a model of a pure and perfect republic, the basis of which is mutual attachment. Humanity prompts us to wish that it were possible to establish republics of this kind among mankind. But such wishes will never be realized, as long as man is not possessed of the peaceable inclinations of the beaver.

The hamster, and some other quadrupeds of the marmot kind, live in similar societies. The honey-bees seem to have a government of a monarchical nature, because the female, or the queen, whom they respect above all, is the mother of the whole hive, however numerous. Their operations in constructing their cells, and laying up stores of provisions, border on the understanding of man, who daily exhibits his superiority in geometry, order, prudence, and patriotism: but the sagacious operations of the bees are neither the effect of pure reason nor of pure mechanism; they proceed from pure instinctive impulses, bestowed on them by the author of nature. Caterpillars also associate for the purpose of building common habitations; they cover whole leaves with their nets, and place their cells on the inside. And so do the common bees associate: their industry has been an object of admiration in the most remote ages.* It is evident that it was not the intention of Solomon to give a description of the industry of the bees in laying up stores for winter, because it is well known from experiments, that these little animals, as many others do, sleep during winter: he only recommends to the indolent, the industry of the

* Solomon's Proverbs, vi. 6—10.

bee. All that he says of the bee, is: "She provideth her meat in the summer, and gathereth her food in the harvest."

In general it is to be observed, that those passages which allude to the instincts of brutes, do not instruct us of their natures, but apply them to the amelioration of the morals of man.

Some animals are gregarious, though they unite not with a view to any joint operation, such as constructing common habitations: their motives of association are mutually to assist and defend each other from hostile assaults. When a herd of oxen are pasturing in a meadow, if a wolf appears they instantly form themselves in battle array, and present their united horns to the enemy. The sheep, stupid creatures as they are, have been seen to join together, and defend themselves against lions and tygers. Oxen and cows, when prevented from grazing together in herds, never thrive as well as when they pasture together; and a single horse, confined in an inclosure, discovers every mark of uneasiness; he will break through every fence in order to join his companions in a neighbouring field. In short, every animal is possessed of an instinct for as-

sociation, and this instinctive principle may be strengthened and modified by various circumstances.

OF THE DOCILITY OF ANIMALS.

MAN is the most docile of all animals that are capable of culture ; by instruction, imitation, and habit, his mind may be moulded into any form ; by science and art it may be exalted to a degree of knowledge, of which the vulgar and uninformed have not the most distant conception ; but the reverse is melancholy. The human mind, when left to its own operation, and deprived of social information, sinks so low, that it is nearly rivaled by the most sagacious brutes. The human mind is endowed with a great number of instincts, which gradually unfold, and produce, after mature age, reason, invention, and science. A diligent attention to the actual operations of nature is sufficient to convince us of it, if we are not fettered by prejudice, or by the vanity of supporting preconceived opinions. Let any one reflect on the progress of children from birth to manhood : at first their instincts are limited to obscure sensations, a stimulating impulse to certain corporeal actions : in a few months we perceive their sensations to be more distinct, their bodily actions to be better directed ; new instincts are unfolded, and they

Assume a greater appearance of rationality and of mental capacity: after being farther advanced, and having acquired some use of language and some knowledge of natural objects, they begin to reason; but their reasonings are feeble, and often preposterous. Thus they proceed in improvement till they are actuated by the last instinct at the age of puberty. After this period, they begin to reason with more perspicuity and justness. But reason, and every other instinct becomes improved and polished by an examination of various natural and artificial objects, by experience and observation, by public or private instruction, by studying the writings of our predecessors and contemporaries, and by our own reflections, till we arrive at the age of thirty-five. Before that time of life, judgment, abstraction, and the reasoning faculty, are not fully matured, though much learning may have been acquired, and much genius may have been exerted. This is the true progress in the operation of nature, and the gradual unfolding of human sagacity and mental powers. And the same progress is to be observed in the powers of the body. It arrives sooner at perfection than the mind; but this is to man a happy circumstance; for

if the progress of the mind preceded that of the body, if the mind were active and vigorous before the organs of the body were able to obey, what a miserable figure would human beings exhibit ! Also, the bodies of men, when properly managed by early culture, are capable of wonderful exertions. Men, who live in polished societies, cannot form an idea of the activity, the courage, the patience, and the persevering industry of savages, when occupied in hunting wild animals for food to themselves and their families. The hunger, the fatigue, the hardships which they not only endure, but despise with fortitude, would amaze and terrify the imagination of any civilized European.

Next to man, the ape-kind are capable of receiving instruction. Their power of imitating the actions of men, are well known. The ourang-outang, a native of the southern regions of Africa and India, is as tall and as strong as a man. Those exhibited for show in Europe and some parts of America, are young and small. Travellers have given us ample descriptions of the structure and economy of this animal. M. de Buffon describes an ourang-outang, whom he saw himself, and who imitated all the common actions of man. He

seemed to want but the power of speech to be an almost rational being. Signs and words were alone sufficient to make him act : he conducted the people who came to visit him, and walked as gravely along with them as if he had formed a part of the company. He, like man, used to sit down at table, unfold his towel, use a spoon or a fork to carry the victuals to his mouth, pour his liquor into a glass, drink tea, and allow it to cool before he drank it. Some historians tell us, that in Africa they learn these animals to perform, like slaves, domestic occupations. But, notwithstanding the great similarity of his structure to those of the human species, his genius and talents seem to be very limited. By long instruction, he learns to imitate every human action, but their speech. He has the organs of speech, but is destitute of articulate language. He might, if proper means were bestowed for instructing him, be taught to articulate some words, as parrots do ; but that would not justify us to exalt him to the rank of man, as long as he remains incapable of reflection, unable to comprehend the meaning of words, or to discover by his expressions a degree of intellect greatly superior to that of the brute creation. Philosophers, indeed, often have occasion to place men in the

class of brutes ; but they will never be justified in placing brutes in the class of man. The difference is too great.

It is worthy of remark, that, whilst the monkey-race in their structure resemble man the most, they cannot be compared to him with respect to mental powers ; whereas, on the contrary, the elephant, who resembles man in mental faculties, in the highest degree, is so infinitely different from him in bodily form : nature has carefully determined the limits between man and the brute.

Of all quadrupeds, the elephant is most remarkable both for docility and understanding. His size is enormous, and his members rude and disproportionate, but his genius and his sagacious manners are almost incredible. He is the largest and strongest of all terrestrial animals. He is mild and peaceable, but naturally brave. He is an associating animal, and seldom appears alone in the forests. The oldest takes the lead ; the next in seniority brings up the rear ; and the young and feeble occupy the centre. They never separate so far asunder as to render them incapable of affording each other mutual assistance when danger

approaches. Wherever they march, the forest or inclosures seem to fall before them. To attack a troop when thus united, would require a little army. When an insult is offered, they instantly move forward against the offender, toss him in the air with their tusks, and afterwards trample him to pieces under their feet, or rather pillars of flesh and bone. But this noble and majestic animal, when not disturbed by injury, never shows any hostile intention either against man or any other animal. They are not blood thirsty, and live entirely upon vegetables. When an individual chanc^es to meet with a luxurious spot of pasture, he immediately calls to his companions, and invites them to partake of his good fortune. His trunk is his chief instrument of sensation. This trunk, which in an elephant of fourteen feet high, is about eight feet long, consists of a large fleshy tube, divided through its whole extent, by a fleshy partition. It is capable of motion in every direction. It answers every purpose of a hand ; for it grasps large objects with great force, and its extremity can lay hold of a small piece of coin, or even of a pin. By this instrument, the elephant conveys large or small bodies to his mouth, places them on his back,

embraces them fast, or throws them forcibly to a distance. The elephant possesses the sagacity of the beaver, the address of the ape, and the acuteness of the dog. His mental talents acquire additional force by experience, for he lives at least two centuries. With his trunk he tears up trees, and by a push of his body he makes a breach in a wall. To his strength he adds courage and prudence. Men and brutes respect him, because he never makes an attack, but when he is provoked. The ancients regarded him as a miracle of nature; some have ascribed to him intellectual powers and moral virtues; and Pliny, Aelian, and Plutarch, have bestowed on the elephant even an innate religion, a kind of daily adoration of the sun and moon, and piety toward his fellow creatures.

The elephant, after being tamed by man, becomes the mildest and most obedient of all domestic animals. He is obedient to his keeper, soon learns the signs and words by which he is guided, and to understand the tones of anger, and of approbation. His movements are always measured and sedate. To accommodate those who mount him, he readily learns to bend his knees. With his trunk he assists in load-

ing himself. He loves to be clothed, and seems to be proud of gaudy trappings. We know of instances that elephants have died of grief and remorse, when in a paroxysm of rage they had destroyed their keepers. "At Dehan," says M. de Bussy, "an elephant from revenge, killed his cornack. The man's wife, who beheld the dreadful scene, took her two children, and threw them at the feet of the enraged animal, saying : Since you have slain my husband, take my life also, as well as that of my children. The elephant instantly stoped, and, as if stung with remorse, took the eldest boy in its trunk, placed him on its neck, adopted him for its cornack, and would never allow any other person to mount it." But such accounts must be confirmed as facts, before the philosopher can draw conclusions from them.

In ancient times, elephants were employed in war, and this is still practised by some nations in India, where they give the elephant systematical instructions for that purpose. An elephant performs more labour than could be accomplished by six horses, but he requires a great deal of food, and must be led to the water twice or thrice a day to drink and to bathe himself. The elephant is employed in carry-

ing great-burdens. He is an excellent swimmer, and therefore of great use in the passage of rivers. When heavily loaded, he spontaneously enters the river, and swims over with his trunk elevated for the benefit of respiration. He is fond of wine and ardent spirits. By showing him a vessel filled with any of these liquors, and promising him it as the reward of his labours, he is induced to exert the greatest efforts, and to perform the most painful task. But to break any promise made to him is extremely dangerous. His cornack would fall a victim to his vengeance. He loves to have children about him, and caresses them, as if he was sensible of their innocent manners. He is proud; but he is also grateful, when he meets with good treatment. When a wild elephant is taken, the hunters tie his feet, and one of them accosts and salutes him, protests that no injury is intended, tells him, that in his former condition, he frequently wanted food, but that, henceforth, he shall be well treated, and that every promise shall be performed to him. This harangue soothes him and he placidly follows the hunter. The elephant is more easily tamed by mildness than by blows. But with all this superiority over other brutes, he is deprived of the power of speech....and the structure of his

body is such, that he cannot be confounded with man.

These are some of the most remarkable instances of the docility of the more ennobled and larger animals. Among the domestic animals, the horse and the dog seem to be the most docile. Their mental powers appear from their memory, their obedience, and fidelity, of which we may convince ourselves by our own experience, or by that of others.... Even the ox, dull and phlegmatic as he is, is capable of being tamed, and of receiving instruction. The oxen of the Hottentots, are favorite domestics, companions in amusements, assistants in all laborious exercises, and participate the habitation, the bed, and the table, with their masters. The Hottentots even train their oxen to war. Among the feathered tribes, the parrot is well known for his loquacity, or rather imitation of certain words or sounds; others are admired for their musical ears, and the melody of their voices. All these effects are results of various causes. They are not necessary consequences of the mechanical structure of their bodies, neither do they proceed from reflection, knowledge, or reason. It is an instinct, improved by habit.

and practice. It is a certain measure of mental power, which by the wise author of nature is bestowed upon all animals, in the same endless and diversified gradation, as the power of life itself.

OF THE MIGRATION OF ANIMALS.

MANY birds, and especially the swallows, periodically migrate from one climate to another. But even in the same climate and country, birds occasionally perform partial migrations; during hard winters, some retire from the inland parts of the country to the sea-shores; others resort to gardens, and the habitations of men, in order to procure food and shelter. Only those that migrate to distant climates, are called birds of passage. But all birds are, in some measure, birds of passage, though they do not migrate to places so remote from their former abodes. The bird-catchers well know how to profit by these partial migrations.

Migration has been generally supposed to be peculiar to the feathered tribes; but from the same causes, which compel these creatures to change their places of abode, that is, to acquire a more commodious station with regard to food, temperature, and shelter, men have migrated in multitudes from north to south, to displace the native inhabitants, and to fix establishments in more comfortable climates than those which they had relinquished. These, in

their turn, have fallen victims to fresh and barbarous emigrants. Among the northern nations, as Norway, Sweden, Scotland, &c. though they are strongly attached to their native countries, there seems to be a natural propensity to migrate. Poverty, the rigor of climate, curiosity, rapacity, the false representations of interested individuals, the oppression of feudal barons, religious persecutions, and other causes, have given rise to great emigrations of the human species. The emigrations from south to north are less frequent, and indeed very rare. The cause of it is conspicuous. Man, especially in the youthful periods of life, has a strong inclination to visit places that are distant from his ordinary residence ; and if such travels are undertaken and performed with a spirit of observation, they will expand our faculty of thinking and reasoning, and augment our knowledge of men and things. Without the principle of migration, mankind would never have been so universally diffused over the surface of the earth ; and to this instinct of migration, we are indebted for the most important discoveries. Who is it that would not remember with admiration and gratitude, the names of Columbus, Banks, Cook, Bruce, Vaillant, and of other circumnavigators, and

travellers? This instinctive desire for migration, however, is counterbalanced by a strong attachment to our native countries. After gratifying the migrating principle, almost every man feels a longing desire to return.

Quadrupeds likewise perform partial migrations. At the approach of winter, the stag and the rein-deer leave the tops of the lofty mountains and come down to the plains for food and shelter. When summer commences, they are harassed with swarms of insects, and to avoid them they regain the summits of the mountains, whither these enemies dare not follow them. In Norway, and the more northern regions of Europe, the oxen and sheep during winter migrate to the shores of the sea, where they feed upon sea-plants and the bones of fishes ; and in Lapland the inhabitants are from time to time visited by myriads of rats : in their march they uniformly pursue a straight line, and neither a lake, or any other obstacle, can make them alter their direction, for they either traverse it or perish in the attempt.

Frogs, immediately after their transformation, leave the water, and migrate to the meadows or marshy grounds in quest of insects.

But of all migrating animals, particular kinds of fishes make the longest journies, and in the greatest numbers. The salmon frequents northern regions alone, and makes regular migrations: for the purpose of depositing their spawn, they quit the sea in the month of September, and ascend the rivers: when they find a place which they think proper for depositing their eggs, the male and female unite their labours in forming a convenient receptacle for the spawn in the sand, which then lies there till the spring, and after this office has been performed, they hasten back to the sea.

Herrings are likewise actuated by the migrating principle. These fishes are chiefly confined to the northern and temperate regions of the globe: they appear in vast shoals on the coast of America; but the great winter rendezvous of the herrings is within or near the arctic circle, where they remain several months. They begin their migration southward in the spring, and appear off the Shetland Islands in the months of April and May. But the number that arrives in June is immense, and their approach is recognized by particular signs, such as the appearance of certain fishes, the vast number of birds, &c. When the main body ar-

rives, it changes the appearance of the ocean itself. The shoal is generally divided into columns of five or six miles in length, and three or four in breadth. Their motion creates small undulations in the water. When the sun shines, a variety of splendid and beautiful colours are reflected from their bodies. Their instinct of migration seems not to be prompted by a scarcity of food, it rather seems to proceed from a desire to deposit their spawn in warmer and more shallow seas than those of the frigid zone.

The bees, the wasps, the ants, and many of the insect tribes follow this migrating principle. It is not confined to any particular species, but extends through almost the whole system of animation. Men, quadrupeds, birds, fishes, reptiles, insects, all afford striking examples of the migrating principle, and the general motives for migrating are similar in every class of animals. Food, multiplication of species, and a comfortable temperature of air, are evidently the chief causes which induce animals to remove from one place to another. But, previous to actual migration, what are the peculiar feelings of these animals, and what should stimulate them to proceed uniformly in the direction that ultimately leads them to the situa-

tions most accommodated to their wants and constitutions, belong to those mysteries of nature, with regard to which, like every other part of the economy of nature, the philosopher dare not attempt to push his inquiries beyond the bounds of human abilities ; his duty is to observe a respectable silence.

OF THE PRINCIPLE OF IMITATION.

ALL animals, particularly those of the more perfect kinds, are endowed with the principle of imitation. In man it appears at a very early period of his existence. In the more advanced stages of life, it is so interwoven with other motives of acting and thinking, that it is difficult to distinguish it as a separate instinct, and equally difficult to conquer the habits and prejudices to which it has given rise. The less a man is in the habit of thinking, the more powerful is the instinct of imitation over his actions and his manner of reasoning. Most women, are more influenced by the behaviour, the fashions and the opinions of those with whom they associate, than men. We should, therefore, learn the extreme danger of frequenting the

company of the dissolute and unprincipled. Bad language and bad examples corrupt the morals. Bad habits are soon acquired, but very difficult to conquer. However, so benevolent is nature, that the principle of imitation acts with redoubled force, if men, especially when young, are fortunate enough to fall in with society of the virtuous and intelligent. We are, indeed, prone to evil, but when not corrupted by improper imitations, nature has made us much more prone to good. We cannot resist the beauty of virtue, if by good examples it exhibits to us its charms. Children are extremely alert in imitating the actions, the gestures, and the manners of those with whom they associate; they are dexterous in perceiving ridiculous representations, which they imitate with ease. Hence we perceive in the education of children, the infinite importance of regulating the principle of imitation. Artificial languages, also, we learn entirely by imitation, which distinguishes us more than any other circumstance from the brute creation.

The instinct of imitation is not less powerful in brutes; they soon acquire thereby all the knowledge possessed by their parents. They derive experience from their own feelings, and

by imitation they learn and employ the experience of others. The young see their seniors fly and approach a particular object : this they at first imitate, and by practice it becomes to them habitual. Many other instincts, as terror upon hearing particular sounds, the appearance of natural enemies, the selection of food, &c. seem to be partly the effects of imitation. Dogs begin to bark, when they hear other dogs bark ; and young children are the most sprightly and active in the company of their playmates. Those dogs which in China are fated for eating, and which are of a pale yellow colour, are by habit brought so far as to lose all relish for animal food or carrion : they are fed with rice-meal and other farinacious food. The dogs in South-America, and the islands of the south sea, are fed in the same manner. However, nature can never be entirely conquered. On the first opportunity offered to them, they discover an inclination to hunt and to devour flesh.

CHARACTERISTIC OF ANIMALS.

Nature has imprinted on every animal a certain character, a certain indelible mark of distinction, which we discover by the actions, the air, the countenance, the movements, and the whole external appearance. The courage of the lion, the ferocity of the tyger, the voraciousness of the wolf, the pride of the courser, the indolence of the ass, the cunning of the fox, the affection and docility of the dog, the subtlety and selfishness of the cat, the mildness of the sheep, the timidity of the hare, the vivacity of the squirrel, are proper examples. By the influence of domestication, these characters may be modified by rewards and punishments, but the original character is never fully obliterated. Those animals which seem to have been destined by nature to live in perpetual slavery under the dominion of men, have the mildest and most gentle dispositions, so that a large troop of oxen often is guided by the whip of a child.

The variety of temper, affections, aversions, and studies we find in the human species, is indispensably necessary for supporting the so-

cial state, and carrying on the general business of life. Some men are formed for study and deep research, and others for action, courage, and the exertion of bodily powers. The same variety in the dispositions and powers of the different tribes of animals is equally necessary for peopling the earth, and for supplying the wants of its inhabitants.

In the human species, beside the general specific characters, individual characters are strongly marked, and as much variegated as their countenances. In every government, and especially in commercial states, human characters are often so disguised by a thousand artifices, that it requires time and experience, before a man can discover the real character even of an intimate companion. A man who to-day shews every symptom of friendship and attachment, will to-morrow be cool and indifferent, if the exertion of his friendship be required. Whilst a man is smiled upon by the sunshine of prosperity a crowd of flatterers, like insects, surround him ; but like insects, they all vanish when his situation becomes altered and the sun of prosperity is clouded by adversity. Many a Judas, under the garb of the most friendly salutation, hides the dagger he intends to plant

into our hearts. This picture of human nature, indeed, is a melancholy one, and we are sorry to remark, is too general ; but, thank heaven, it is not universal. There always were, and still are, men of noble and generous minds, who willingly sacrifice part of their own interest to the welfare of others.

Each quadruped, beside the specific disposition which distinguish the different kinds, possesses a peculiar character by which it may be discriminated from any other. This individual character may be discovered not only by the aspect, but by the actions of animals. Some dogs, even of the same race, are surly and revengeful, and others are gay, frolicsome, and friendly. Nature has marked the countenances of every animal, even down to the insect tribes, with some characteristic strokes, which enable them to distinguish one another, and even to contract particular attachments. We see sparrows and linnets fly about in flocks ; but, when the genial spring arrives, the flocks disappear ; each male selects a female to build a nest, to hatch eggs, and to nourish and support their young. It would appear impossible that the immense multitude who pair, should be capable of distinguishing one another, if nature

had not stamped upon every individual a peculiar mark. Shepherds, among their numerous flocks, know by the countenances, and other natural or accidental marks, every individual, and often give to each a particular name.

It is worthy of remark, that when a man in his countenance bears some resemblance to a particular animal, the dispositions of the man have a striking affinity to those of the animal. Some men, in the general expression of their countenances, resemble goats, others sheep, others oxen, others swine, others lions, others dogs, others foxes, others owls, &c. Men who resemble the fox, are uniformly cunning and deceitful; those who resemble the lion, are bold, open, and generous; those who resemble the cat, are circumspect, designing, and avaricious; those who resemble the ox or the sheep, are in their dispositions dull, phlegmatic, and timid. It is needless to pursue the comparison farther. Lavater, in his *Physiognomy*, has thrown a great light on the subject; and though his imagination may have carried this ingenious author too far, every man's recollection and observation will furnish him with numberless examples, that the external resemblance to cer-

tain animals, is a mark of certain dispositions. This general plan extends throughout all nature. The eagle, a noble and generous bird, represents the lion, the king of the animals; the cruel and insatiable vulture, represents the tyger; the kite, the buzzard, and the raven, represent the hyæna, the wolf, and the jackal; the falcon represents the dog and the lynx; the owl represents the cat; the heron represents the beaver and the otter; peacocks, hens, and other birds which have a crop, represent oxen, sheep, goats, and other ruminating animals.

The best and most infallible rule whereby to judge of the characters of men, is that, given by the most exalted benefactor of mankind;
 BY THEIR FRUITS YE SHALL KNOW THEM!

HERE then we rest! "The universal cause
 Acts to one end, but acts by various laws.
 In all the madness of superfluous health,
 The trim of pride, the impudence of wealth,
 Let this great truth be present night and day;
 But must be present, if we preach or pray.
 Look round our world; behold the chain of love,

Combining all below and all above.
 See plastic nature working to this end,
 The single atoms each to other tend,
 Attract, attracted to, the next in place,
 Form'd and impell'd its neighbours to embrace.
 See matter next, with various life endu'd,
 Press to one centre still, the general good.
 See dying vegetables life sustain,
 See life dissolving vegetate again:
 All forms that perish other forms supply,
 (By turns we catch the vital breath and die).
 Like bubbles on the sea of matter borne,
 They rise, they break, and to that sea return.
 Nothing is foreign; parts relate to whole;
 One all-extending, all-preserving soul,
 Connects each being, greatest with the least;
 Made beast in aid of man, and man of beast;
 All serv'd, all serving: nothing stands alone;
 The chain holds on, and where it ends, unknown.

POPE,

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 THE END.

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